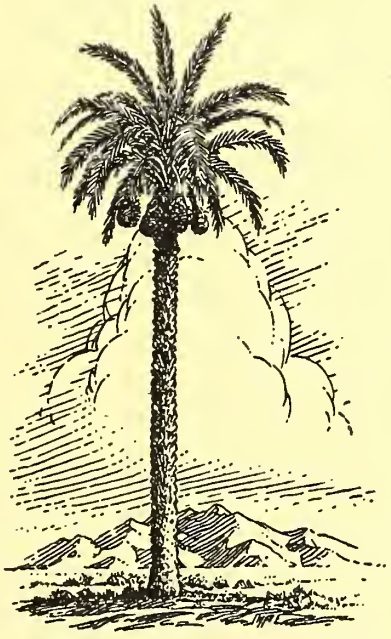
REPORT OF

Twenty-Sixth Annual

DATE GROWERS' INSTITUTE

APRIL 30, 1949



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The Date Growers' Institute, a non-profit, educational organization devoted to furthering the knowledge of date growing, is now in its twenty-sixth year. Proceedings of each Institute have been published, and may be purchased in complete sets, or by separate copies. Direct all inquiries to the Secretary.

MRS. T. R. BROWN
Secretary-Treasurer

Route 2, Box 81
Thermal, California

26th Annual Date Growers' Institute

Saturday, April 30th, 1949

Chairman, Morning Session: Dr. Paul Popenoe, Director, Institute of Family Relations, Los Angeles, California.

Chairman, Afternoon Session: C. W. Van Horn, Supt. Yuma Experiment Farms.

INTRODUCTION

Dr. Paul Popenoe

Director, Institute of Family Relations, Los Angeles, California

When a man gets to reminiscing it makes him feel as though he were an old timer. I took part in the first date institute, but it has been some time since I have had the privilege of sitting in on one of these discussions.

In 1911 when I was making a trip through Europe on $2.00 a day, winding up at Naples I got a cablegram from my father telling me to go to Algeria and get 1,000 date off-shoots. The next day I got a cablegram from Walter Swingle saying he would like to have me meet him in southern Spain the following week. At the commercial date growing center of Elche in Spain I discovered what a date off-shoot really was. I went to Biskra where most of the date varieties from this country have come. I got a thousand Deglet Noor off-shoots, representing my beginning in the practical problems of date growing. At that time the industry was growing rapidly, and there was a wide-spread interest in date growing in this part of the country, the Imperial Valley, and Arizona; also, the San Joaquin and Sacramento Valleys.

As soon as I got back with our first shipment, I started off again with my brother Wilson, making a trip to the Persian Gulf region where we thought we could get some early varieties such as Khadrawi, Halawi and a number of experimental varieties which had the principal merit of being extremely early, which might be adaptable to the San Joaquin Valley, Arizona, and Imperial Valley. We bought 9,000 from there, and 6,000 Algerian conventional shoots, and brought them to this country. Appearance of scale infestation had become familiar to the industry of that time. Quarantines were being clamped down and it was impossible to get any off-shoots into the San Joaquin Valley. We, therefore, could not establish them in the San Joaquin Valley. Most of the off-shoots brought back by my father were sold—some he kept for himself.

The problems in the early date industry were much the same as at the present time. In the Oriental date gardens efficiency was low and methods inferior. Mostly haphazard ways were carried on. Now there is no room for comparison. People in the Orient are looking to us in order to improve their own methods. Development of the date palm is a great matter of importance. There is a need to increase the food supply, and the date palm offers a resource for land which is relatively unfit for any other agriculture.

The annual institute is the form in which new material is presented and offered. Sometimes it is a question of personal privilege and not merely a duty by those working in the field. Difference of opinion not only produces horse races, but produces scientific progress.

Functions of the California Fig Institute

Remarks by PAUL L. JOHNSON, Managing Director

In attending this Date industry meeting at Coachella today, I am interested in noting that it is the 26th Annual Institute of Date Growers. I am reminded that if we were continuing to operate under a similar type of annual conference in the fig industry, it would be the 31st anniversary for what started in World War I days as the Annual Institute of Fig Growers. Undoubtedly our industries have considerably more in common, however, than the fact that the early roots of organization were planted in growers' institutes. Figs and dates are both classified as subtropical fruits and to a major extent, we both seek consumer favor along similar lines, namely as a confection. Fortunately or unfortunately, however, for the fig industry, conditions became so bad in the early 30's that it was found necessary to develop a more thorough and functional type of organization than could be expected under the somewhat voluntary structure of our annual conference of fig growers.

As late as the early 20's, approximately three-fourths of the dried figs consumed in this country were imported from Mediterranean sources. Then in 1927, the Food and Drug Administration began to show a greater interest in the quality and sanitation of figs being served to the American consumer. It became more and more apparent to our people that quality standards must be improved considerably if we were to avoid trouble with the Federal government. Likewise domestic producers and processors must place a better product before the American consumer if they were to replace imported figs, inasmuch as tariffs were inadequate to equalize domestic and foreign costs of production. As we entered the depression era of the early 30's, however, there were new problems to complicate the picture. Large segments of our industry were in bankruptcy or near bankruptcy and a substantial portion of the industry's acreage was owned by banks and other lending institutions. Although it was recognized for some time that the industry must take steps toward organization to save itself from complete collapse, it wasn't until 1935 that ac-

tion was finally taken. It seems unfortunately true that many farmers do not admit the need or show the willingness to organize until sheer desperation forces them to do something. Our American individualism is a wonderful trait, but it can be a mighty expensive one when it is permitted to stand in the way of organized and concerted activity for mutual benefit.

Things were very desperate in the fig industry when along in 1935 the initial efforts were made to establish an industry wide service organization devoted to working on the numerous problems which almost continuously confront any industry. The first year or two seemed largely devoted to a study of these problems on an industry-wide basis and to an educational program of developing an understanding in the minds of the nearly 1,000 growers and packers in the industry of the need for organized efforts if anything substantial could hope to be accomplished.

At this time, I think it well to call attention to one factor which I feel has had a large share in the success of the fig industry organization. Human nature being what it is and especially so in our American system of competitive endeavor, we find too many people have a warped idea of how to achieve the greatest success from an industry organization. They are the kind of people who sit on boards of directors or come to meetings for the sole purpose of doing things which to them individually and primarily will be most beneficial. It is tragic that they fail to realize that only through a sound business community or a stable industry can the individual members of that community or that industry hope to achieve individual prosperity. There are undoubtedly numerous instances in which a fast deal will revert to individual benefit but the long range injury done by such policies of selfish administration can only result ultimately in collapse for the over-all business structure. The old rule of "what would I do if I owned all of the industry" is a test which frequently can form the foundation for intelligent action. During an extended period the Fig Institute had as chairman of its board of directors, a man who had no personal investment in the fig industry and who was therefore completely neutral in his recommendations of policy. No suspicion of personal interest existed. Through the inspiration of his leadership, our various directors and committeemen were encouraged to apply the industry wide test to problems which confronted them. Their sound administration has made possible the selection of good management and has extended to that management complete authority to carry out policies adopted by the industry.

In a discussion of the fig industry organization, it is perhaps confusing to intimate that the California Fig Institute is the fig industry, when actually there are four different industry wide organizations which have in time taken their place in our functional organization. Following the incorporation of the California Fig Institute in 1935 as a predominately grower organization devoted to the general welfare of the California fig industry, study was directed to the various problems which required immediate attention.

As the Institute developed, its activities have taken two directions. Its regulatory activities have been implemented by the use of State laws authorizing marketing programs. Its general welfare functions have been carried on within the framework of the Institute itself. For many years the Institute has done considerable work in publicizing the quality, flavor and nutrition of California figs. During the early years, the program was carried on almost entirely by use of institute funds. For the last few years, however, we have been operating under a voluntary agreement within the industry whereby packers and growers contribute matching funds for an industry-wide advertising program. This program advertises and promotes the sale of California figs and fig products without regard to brand, producer or packer. This program is carried on through the employment of capable advertising counsel, operating under the supervision of the Institute management and an advertising committee.

In order to bring about advancement of cultural practices in the growing of figs and improvement of natural quality, the Institute has continually expanded its research activities until we now have our own laboratory staff housed in a fine new building near Fresno. In addition to carrying on their own research projects, they seek to coordinate the activities of various university, government and private agencies working on our industry problems.

On numerous occasions during its history, the Institute has represented the California fig industry in tariff matters, trade agreements, government quality and grade regulations and numerous other matters in which it is of tremendous assistance both to the industry concerned and to government officials to have one industry organization which is recognized as speaking for all factors. Almost single-handedly the California Fig Institute during the past two years has handled negotiations with the U. S. Department of Agriculture for the disposal of such fig surpluses as has existed during the post war readjustment period. Fortunately for fig growers, the problems of surplus in our industry are not insurmountable.

It was early recognized in the Institute that the industry must do something to withhold from the market, figs of obviously low quality. In order to accomplish this, there was adopted in 1937, under the authority of the California Agricultural Producers Marketing Act, a compulsory program establishing minimum standards of quality for natural condition figs which growers could sell to processors. Figs are a fruit which inherently by nature have defects which no amount of processing or sorting is able to completely eliminate. For this reason, lots of figs incapable of meeting satisfactory quality standards are required by law to be diverted into non-competitive by-product outlets. This program has gone along without interruption for every year since 1937. It has withheld from the market from fifteen to twenty-five percent of all figs produced. It is the responsibility of the Program Committee to prevent substandard figs from competing with merchantable figs or figs which have been certificated for satisfactory quality.

In order to assure that substandard figs are prevented from entering normal channels of trade, the Program Committee operates a substandard pool wherein these low grade figs are sold for such purposes as cattle feed, non-edible syrups, alcohol distillation and similar non-competing outlets. We do not expect to derive a profit from substandard or low grade figs but we recognize that the cost of disposing of this minor portion of the crop is the price which must be paid to assure a stable market for the good quality which makes up the bulk of the crop. This marketing program to which I have referred is strictly a grower program in that by self regulation, fig growers agree to withhold from processors plants any portion of the crop which would tend to be destructive of a stable market. We have had our troubles in past years with dry yard operators who were the scavengers of our industry and who contributed to most of our quality difficulties and market destruction. These people have now found it unprofitable to operate under present industry marketing regulations and the few remaining dry yard operators are for the most part a legitimate factor serving the smaller growers in our industry.

Until 1944, most of the efforts toward industry organization for dried figs were provided by growers with the cooperation and assistance of our processors. In 1944, however, the processors found it desirable to adopt a quality program, also under California law, whereby processed figs being shipped to the trade would be in complete harmony with Food and Drug regulations and other State and

Federal laws, while at the same time standardizing the products of the industry. Under this marketing order, no California dried figs may be sold in United States or Canada which have not been certified for quality by our inspection agency. The grower marketing program is used to eliminate culls and low grade fruit, to stabilize market prices and to bring supply and demand into balance by restricting over-all volume if it appears desirable and necessary. The processor marketing order seeks primarily the improvement of quality and consumer acceptance of the processed product.

I think it is fundamental that we recognize that stable markets cannot be built upon a foundation of substandard or low grade merchandise. We have various grades of products in the fig industry, but fundamentally our marketing regulations serve to standardize the quality of the product and remove from the market those grades of figs which will not give consumer satisfaction or which may be found to be in excess of market requirements.

In advance of each season, growers and packers meet for the purpose of discussing such relevant and vital problems as marketing outlook, crop prospects, potential quality of the oncoming crop and other matters having a bearing upon trade demand, marketable supply and quality. It is at these times, and at these times only, that we determine the grade standards that will prevail throughout the entire season. It is an inviolate rule that after a season has once commenced, we do not alter standards for marketable fruit. It is not only unfair to producers and processors in the industry but it is demoralizing to market and trade confidence. At that time we also determine on the amount of industry advertising and establish assessment rates for this purpose. All merchantable tonnage contributes to the advertising assessment. We establish operational policies for the surplus and substandard pools and tonnage once removed from marketing channels through these operations must not be permitted to return to these same marketing channels or you will serve to destroy the very balance of supply and demand which you have sought to establish in the minds of the industry and the trade through the existence of such a program. Through experience it has been found that only on an industry wide basis can a satisfactory job of policing be done to enforce the requirements that low grade figs be kept off the market. It likewise is true that only through the accumulation of this tonnage in one central control can the best job of marketing and disposal be accomplished. Because of its non-competitive nature with good quality fruit, it must enter into other marketing channels wherein the various competitive factors cannot be fully known to each individual grower or processor in our industry. The by-products end of our business can best be exploited on an industry-wide basis.

In review, we find that the California Fig Institute is the focal point for all industry activities. It is composed of all growers in the industry as regular members and processors and other industry factors as associate members. It automatically assumes responsibility to act for all factors in the industry in matters concerning their general welfare. Although it does not market figs or fig products, it operates as agency to bring stability to prices by influencing various factors which contribute to stable markets. In the furtherance of this responsibility, it has brought about the adoption by the industry of a grower marketing program with its substandard and surplus pool operations which is both a quality and a volume regulator. It has likewise cooperated with processors in the industry in the adoption and the operation of a processor marketing order which seeks to improve quality of the processed product and thereby enhance the reputation of California dried figs and dried fig products among the trade and the consumers of this country. It provides the administrative facilities and the leadership in a joint grower-packer advertising and sales promotion program designed to increase consumption and consumer appreciation of California figs and fig products.

Through cooperative effort in an industry-wide organization, fig growers and packers have been able to gain for themselves the benefits of unified organization while at the same time maintaining their competitive stature as independent growers and packers.

Packing House Developments

Frank Winter
Associated Date Growers and Packers, Indio, California

When I was asked to make a report on developments in date packing houses, it occurred to me to scan over some of the earlier institute reports to see what some of the observations were of the "Veteran Date Men." I was surprised at the accuracy of the predictions of such men as Mr. R. H. Postlethwaite, Robbins Russell, W. R. Barger and particularly of a remark made by Mr. Truman Gridley in the very first Institute report.

Mr. Gridley, discussing methods of cleaning dates, referred to the usage of water as a cleansing agent. He stated that water was still the best agent available for cleaning, but its usage was fraught with many complications. I wonder if he realized the importance of his statement at that time, and that in 1949 a packing method paper would be presented in which the main subject would be a discourse of the washing of dates. I hope Mr. Gridley is here today.

Just what is it that produces developments in packinghouse technique and causes changes over the years? Other than the competition so necessary between packinghouses, and the striving of individuals to better their organization's efficiency, there are certain factors definitely affecting modern day packing in the date industry. These can be classified as follows:

1. Diminishing returns to growers thereby necessitating reduced costs in packing houses.
2. Consumer demand and acceptance of a "high-moisture" product.
3. The introduction of the "wet-washer."

DIMINISHING RETURNS TO GROWER

Though the above subject is a touchy one to be discussed here in the Coachella Valley, it is an unfortunate fact that the accumulation of growing costs, packing costs, shipping and selling, deducted from what the consumer is paying, leaves little for the grower. It behooves us packers to do our part in cutting some of the costs.

Probably the first notable change in packing is the method of feed to the cleaning and grading lines. Where, in the past, it had been customary to feed each line separately, it is now the practice to have one source of feed, with a long feeder belt, and shear-offs to each grading line. The result is that one man can transfer some 40 to 60 thousand pounds of dates a day to the production line, where in the past it took six or seven men to do the same job.

After diversion to the grading lines the handling methods vary according to the variety and type of dates being graded. The packing of the so-called "soft" or invert sugar dates will first be discussed.

Where, formerly, invert sugar dates had been divided into countless grades, size, and classifications, it was decided this past season, by our packinghouse, to run one uniform grade and concentrate on removal of such defective dates that would spoil that grade.

Upon coming out of the washer, the one broad grade was diverted directly into the packaging line for the "mold-control" treatment, which will be discussed later. From this line the dates were fed into the wrapping machine. After sealing, no further handling was necessary. This sounds like a simple method of handling a highly perishable product, and it is. Although the handling of invert sugar dates in such a manner may not meet with the approval of all packers, it has demonstrated that long hours of traying, drying, grading, and regrading are not necessary.

The Deglet Noor dates, after diversion to the grading belts are broken down into the "dry" and "natural" classifications, and here again speedier, more direct methods have been followed. New methods of softening of the dry dates have been developed by more than one packinghouse and, although hydrating will probably be the practice for many years, it is hoped that the present experiments with quick softening methods will eventually reduce the amount of time and expense now carried by the dry fruit.

The "natural" or softer Deglet Noor are diverted immediately to the bulk or packaging lines when possible, although some maturation or drying is still necessary. Like the invert sugar dates, the packaging with "mold control" has resulted in a great saving of time and labor.

By way of closing the first subject of cutting costs, it is the belief of the writer that until the day that the packers can get the dates out of the packinghouses shortly after delivery of the field run fruit, the packing costs will continue to be one of the heavy "deducts" from the growers return.

CONSUMER DEMAND AND ACCEPTANCE OF A HIGHER MOISTURE PRODUCT

The packers of dried fruits have, in recent years, discovered that consumer preference is for a more tender and soft product rather than one of a dried out nature. The best evidence of this is the appearance of advertising statements of "soft", "softenized", "tenderized" and other such expressions.

Packing of high-moisture products necessitates extreme care in plant sanitation and the use of various mold control practices. Where the product is to be packed with moisture contents of over 23%, spoilage and returned shipments will face the careless packer.

As pointed out by Dr. Mrak and Vaughn in earlier reports, the use of various detergents and care of grading equipment is essential. Micro-biological spoilage can be of as serious consequence to a date packing house as to a cannery and for this reason methods of grading belt cleansing have been developed thanks to the combined efforts of the engineers of several of the packinghouses.

The installation of belt cleansing equipment, the arrangement of a schedule for chlorination of cloths used by the packers for wiping hands, the careful cleaning of all grading equipment after each shift are all developments of recent years and are representative of changes within the packing plants.

The methods of mold control vary with the different packinghouses, but the general theory does not differ. Epoxide gases are used either in the form of ethylene oxide in the nature of carboxide gas, or propylene oxide in its liquid form. Both gases are explosive under certain conditions and the need of trained personnel in handling the mold-control is apparent.

If the above subject seems to be touched upon with some brevity, it is because of the comparative recentness of the trend toward higher-moisture packing.

INTRODUCTION OF THE WET WASHER

It is with the introduction of the method of washing dates with water, that perhaps the greatest changes in packinghouses are apparent over past years. Although the unsatisfactory toweling and dry brushing methods will be used to some degree, the great volume of fruit that can be handled, and the cleanliness obtained, will induce more and more packinghouses to convert to water washers of one form or another.

As Mr. Gridley stated, the use of water brings on many complications, notably the danger of souring or fermentation and build up of bacteria in carelessly handled washers.

Careful surveillance of washers and general good housekeeping will prevent spoilage troubles and make it possible for the housewife to purchase a properly washed product to which privilege she is entitled the same as for canned or frozen products.

The drying of dates after washing has not proven the problem anticipated. By the use of blower and agitation, most of the excess water can be removed from the fruit by the time it reaches the grading belts. Provided the grading belts are continually cleaned and scraped dry, the fruit passing over them will retain its cleanliness until the application of the mold-control treatment, after which proper packaging will guarantee delivery of a product to the consumer that is as close to fresh as possible.

CONCLUSION

The writer of this paper has attempted to present recent developments in packinghouse techniques, and the reason for the developments. An exchange of ideas by the various packinghouses is essential and it is hoped that, at the next institute, representatives of other packinghouses will present their views. Another year should see greater improvements and more direct methods of handling California Dates.

Date-Bunch Covers and Their Relation to the Fruit-Spoilage Complex of Deglet Noor Dates[1]

D. E. Bliss, D. L. Lindgren, W. D. Wilbur, and L. E. Vincent[2]

The practice of covering date fruit bunches to protect them from injury by rain, insects, and birds has undergone various developmental stages in the United States during the last thirty years. According to Boyer (6), Mr. Bruce Drummond of the U. S. Date Garden, Indio, California, first made, in 1919, some baglike date covers of heavy wrapping paper and provided part of them with holes for ventilation. A more durable cover consisting of a double-layer, asphalt-filled "Ripple Kraft" paper bag was used experimentally in 1920, but with disastrous results, because the heat and moisture trapped by the bag tended to induce the development of fungus spoilage of the dates. A paper tube of single-layer unfilled "Ripple Kraft" was used the following year and proved to be much more satisfactory. Many other types of covers have been tried, such as burlap barley sacks, water-proofed and paraffin-filled muslin, and rain coats with zippers, but most of these have been discarded for one reason or another. The principal change in the manufacture of paper covers during the last twenty years has been the addition of wax, supposedly for the purpose of making the paper stronger and more water-repellent.

The materials now being used for date-bunch covers in the Coachella Valley of California include (a) different kinds of white untreated muslin for wrapping bunches of the early maturing soft varieties, and (b) waxed crepe-paper tubes for making umbrella-like protectors over bunches of the Deglet Noor and other late-maturing varieties. An adjustable two-piece cover designed by A. E. Collins and R. S. Dillman (7), of Bard, California, is used on the Saidy variety in districts where rainstorms occur somewhat more frequently during the fruit-ripening season.

Fifteen years ago Albert and Hilgeman (1) typified the ideal fruit protector as waterproof during heavy rains, allowing circulation of air throughout the fruit cluster, requiring minimum handling during fruit picking, excluding insects and birds, and costing only a nominal amount. Such a protector had not then been devised, and today we are still searching, not only for such a protector, but also for one that protects the fruit stalk and strands from sunburning. The problem has been to provide a moderately dry atmosphere and favorable temperatures about date fruit bunches that are adequately protected from rain, insects and birds. This problem would be relatively simple if it were not for the water vapor constantly transpired from the fruit surfaces.

Haas and Bliss (8) found the loss of water from Deglet Noor fruits to be much greater at high temperatures than at low. In 24 hours, a bunch of 900 full-grown dates loses about one cup of water at 70° F. and about twelve cups at 122°. This moisture comes as water vapor from the stomata (breathing pores) of the fruit. Moisture from uncovered bunches is quickly dissipated in the surrounding air. In covered bunches, however, some of the moisture is trapped, and the resulting condition tends to promote water injury and fungus infection. Minute droplets of water were observed by Nixon (10) on dates early in the morning after a very humid day.

Nixon (10) and Haas and Bliss (8) found the amount of fruit checking (water injury) to be increased by the use of nonporous covers, especially when they were applied as early as July. Conversely, this type of water injury was reduced by separating the fruitstrands and by providing air vents in the covers (8, 2, 4). It was also found that such aeration of the date fruit bunch reduced the amount of fungus spoilage, but that excessive aeration in dry years tended to increase the shriveling of the fruit (2, 4, 9).

Paraffin-treated paper covers were effective in keeping the fruit relatively dry during the torrential rainstorms of 1939, whereas unwaxed paper covers were not (4). Lifting the skirts of the covers, after the storms, was beneficial because increased aeration obtained in this way helped to dissipate the moisture that was present.

In 1947, Lindgren, Bliss and Barnes (9) reduced the infestation of dates by the nitidulid beetles from 12.3 to 2 percent or less by entirely enclosing Deglet Noor fruit bunches in tubular covers made of fine-mesh cotton marquisette. The infestation under some covers treated with benzene hexachloride was entirely eliminated, but this treatment was not satisfactory because of a disagreeable taste imparted to the dates that touched the nets.

Nixon and Reuther (11), in studying the Halawy and Khadrawy varieties, observed that dates on that part of a bunch most exposed to direct sunlight ripened a little earlier than other dates in the bunch. This was attributed to the higher temperatures occurring for several hours each day in the more exposed dates. Paper covers over the bunches caused a slight retardation in ripening, probably because of a reduction in the rate of dehydration of the fruit during the ripening process. Brown paper covers increased the sunburning of fruitstrands, and, in the more severe cases, this injury was accompanied by shriveling of the dates. Under white paper covers, where, during hot summer days, the temperatures were lower by 10 degrees to 35 degrees Fahrenheit, sunburning did not occur.

In our efforts to control the fungus diseases and insect infestations of the date, we were also confronted with the limitations of the brown crepe-paper tube as it was being used on the Deglet Noor variety. Although known to be effective as a protection against rain and birds, this tube had several faults. Being waterproof, it retained the moisture of transpiration; being dark-colored, it absorbed radiant energy from the sun; and being open at the bottom, it allowed insects to enter. Various materials and designs for covers were considered in an effort to retain the advantages and lessen the disadvantages of the waxed brown crepe-paper tube.

The present paper is a progress report on field experiments of the past crop year (1948-1949), on date-bunch covers and their relation to the fruit-spoilage complex of Deglet Noor dates.

MATERIALS AND METHODS

Experimental Date-Bunch Covers.—Of the twelve treatments given date bunches in these experiments, ten differed from each other only in the type of cover used. Of the ten types of covers, seven were made of paper, two were of cloth, and one was a combination of paper and cloth.

The paper selected for the covers was 55-pound, No. 1 Kraft, which is

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[1] Paper No. 605, University of California Citrus Experiment Station, Riverside, California.

[2] The writers wish to express their appreciation especially to Donald H. Mitchell and H. L. Cavanagh, in whose orchards the experiments were conducted; to the Longview Fibre Company, Longview, Washington, for making and testing experimental paper covers; to Deering, Milliken & Co., Inc., New York, N. Y., and to the Scheniman Paper Co., Indio, California, for supplying experimental materials and paper covers; and to Paul D. Gerhardt, for assistance.

naturally brown in color. Part of this paper was bleached (whitened) to produce a No. 1 Bleached Kraft paper of the same weight. Both the brown Kraft (brown A series) and the Bleached Kraft (white C series) papers were then given certain types of processing before being creped to 33 1/3 per cent stretch and made into tubes 36 by 44 inches for date-bunch covers. The papers used in making the brown A1 and the white C1 paper covers had had the normal rosin size treatment and 8 pounds of dry wax (15 per cent of 55 pounds) absorbed into the sheet. (Most of the paper covers now being used commercially on the Deglet Noor variety have this same processing.) In contrast to this, the papers for the brown A2 and the white C2 paper covers had had higher-than-normal rosin size plus the Melamine wet-strength treatment for a moderate degree of wet strength, but no wax. The papers for the brown A3 and the white C3 paper covers had had higher-than-normal rosin size, the Melamine wet-strength treatment to give a moderate degree of wet strength, and 8 pounds of dry wax absorbed into the sheet.

Some of the brown A1 paper covers were altered to make an additional type of cover, in which six evenly spaced "breather" holes were cut 8 inches below the upper edge of the tube to increase ventilation in the fruit bunch. These holes were triangular in shape, 2 inches wide at the base and 4 inches high, and the flaps remained attached at the base.

The cloth covers were also made in the form of tubes, but they were 16 inches longer than the paper covers (36x60 inches) and were of two kinds, one made of water-repellent muslin, and the other of untreated cotton marquisette netting.

The combination paper-and-cloth covers were similar in size to the cloth covers. Each consisted of a white C1 paper hood, 36 by 22 inches, sewed to a skirt of marquisette netting.

At the time of installation, all the covers were raised about the fruit bunches, gathered at the top in such a manner as to prevent the entrance of water, and tied securely to the fruitstalks above the strands. The skirts of the cloth covers were also gathered and tied below the fruit bunches to prevent the entrance of insects.

Experimental Plots. — Experiments were conducted in similar test plots in two commercial date gardens in which good orchard management is practiced. Plot I was situated 2 miles south of Indio, California, in a district in which fruit matures early; Plot II was in the Indian Wells district, 5 miles west of Indio, where dates ripen moderately late in the season. Each plot consisted of 15 medium-sized Deglet Noor palms situated well in from the edge of the planting and free from interplanted crops, except for small citrus trees in Plot I. Well-pollinated, uninjured fruit bunches of midseason development were selected for the experiment, at the rate of 5 or 6 per palm.

Treatment of Fruit Bunches.— Twelve types of treatment, including two control treatments and ten experimental treatments, were assigned to the selected bunches in such a manner as to give an orderly but impartial arrangement. Care was taken to obtain an equal distribution, on different sides of the palms, of the 5 to 7 fruit bunches receiving the same treatment in each plot.

Except for sulfur, which was applied uniformly to all fruit bunches in June as a protection against the date mite, *Paratetranychus simplex* (Banks), the bunches of Control A (treatment 1) were left without further treatment. Beginning on July 20, the bunches of Control B (treatment 2) were aerated by means of 9-inch corrugated wire rings (fig. 1, A) (4); these bunches were also dusted with Thiomate "19" (3, 5), a fungicidal mixture of 5 percent Fermate in sulfur, but they were not protected by any cover. All the remaining bunches (experimental treatments 3 to 12, inclusive) were treated like those of Control B except that each had one of the experimental covers, as previously described. These covers were installed on August 17, when a second dusting of Thiomate "19" was applied (fig. 1, B). On September 15 wire baskets were suspended under the fruit bunches of treatments 1 to 8, inclusive, and of treatment 12, to catch falling dates. Baskets were not needed under the remaining bunches because they were inclosed in cloth covers. A third application of Thiomate "19" was given the treated dates in Plot II on October 19, after a rainstorm, but was withheld from Plot I, where the fruit harvest was nearly finished.

Picking and Grading Operations.— Ripened dates were picked from the experimental fruit bunches at 2-week intervals, using a method similar to that of previous experiments (9). Six pickings were made in Plot I from September 15 to December 7, and seven pickings were made in Plot II from October 10 to February 17. Each reading of insect infestation was made from a 50-fruit sample collected at random from a fruit bunch at the beginning of a picking and securely tied in a new paper sack to prevent escape of the insects. Each reading of fruit quality, tearing from water injury, and fungus spoilage, was made from a 100-fruit sample taken at random from the remaining dates after they had been fumigated with methyl bromide.

ENVIRONMENTAL FACTORS

In 1948 the weather in the Coachella Valley was generally favorable to date culture, as evidenced by the fact that the California date industry harvested the second largest crop in its history, a crop of relatively high quality.[3] There were two rainstorms, however, that caused injury. Considerable fruit checking occurred in connection with a storm on July 22 and 23 (table 1), but since the dates were at that time in the late kimri stage of maturation, they were practically immune to fungus spoilage (16). Much of the unprotected fruit in the later-maturing districts was spoiled by the tearing and fungus infection that followed a second storm on October 17-19, inclusive, when many dates were in the khalal and rutab stages of maturation. Fortunately for the growers, much of the crop had been dusted with Thiomate "19" and protected with waterproof covers before the second storm. Furthermore, the weather after this storm remained too cool for the development of rapid alcoholic fermentation of sugar in the torn dates, or for a noticeable build-up in the population of nitidulid beetles.[4]

During a 24-hour period, September 7-8, 1948, readings were taken in Plot I to measure the relative humidity and temperature of the air both inside and outside various experimental date covers. This period was considered to be fairly typical for that season of the year, with relative humidities of the free air ranging from 25 to 72 per cent and temperatures ranging from 67° to 104° F. (fig. 2). No conditions within the date covers were thought to be conducive to fruit spoilage, but certain tendencies that were noted should be of interest to date growers: When the data were plotted against time (fig. 2), the curves for the relative humidity and temperature of the air were found to be related inversely. This result bears out a well-recognized principle, namely, that a given amount of air can hold less water vapor when it is cold than when it is warm.

During the period of observation, a relative humidity of 58 per cent was recorded in open air at 6:00 A.M., when the temperature was 67° F. This air would have become saturated with water vapor (would have reached the dewpoint) if the temperature had fallen to 52°. Since the relative hu-

[3] Solt, Maure. Weekly packout report. California Dept. Agr., Date Advisory Board. 1948-1949. (Mimeo.)

[4] **Carpophilus hemipterus** (L.), **C. dimidiatus** (Fab.), **Urophorus humeralis** (Fab.), and **Haptoncus luteolus** (Er.), all of the order Coleoptera, family Nitidulidae.

Table 1.—Rainfall Recorded at Palm Springs and Indio, California, July, 1948, to February, 1949, Inclusive*

Date	Rainfall, in inches	
	Indio	Palm Springs
1948:		
July 22	Trace	.....
23	0.48	2.80
Aug. 1-31	.....	.....
Sept. 16	Trace	.....
Oct. 13	Trace	.....
17	Trace	0.40
18	0.91	0.10
19	0.40	.....
30	.....	Trace
Nov. 1-30	.....	.....
Dec. 4	.....	Trace
17	Trace	.....
22	0.01	0.09
23	0.08	.....
27	0.02	0.40
28	Trace	.....
1949:		
Jan. 9	.....	0.02
10	.....	0.05
11	0.02	0.54
12	0.71	0.15
13	1.18	1.24
14	Trace	0.02
20	Trace	.....
21	Trace	Trace
23	Trace	0.02
24	.....	0.04
25	Trace	.....
Feb. 8	Trace	.....

*Climatological Data, California Section, U. S. Weather Bureau, Vol. 52, 1948, and Vol. 53, 1949.

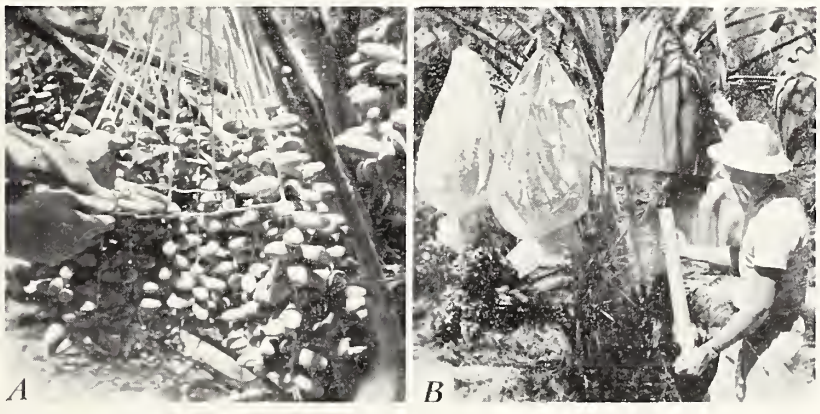

FIGURE ONE

Methods of controlling date-fruit spoilage: A, insertion of a corrugated wire ring between the strands of a fruit bunch; B, application of Thiomate "19" to a fruit bunch after the installation of a brown paper tube. Note cloth cover (extreme left) and paper-and-cloth cover (center).

midity did not reach 100 per cent, no water of condensation (dew) was deposited on the fruit surfaces, as sometimes observed (10, 5). Some moisture was added to the air during the next seven hours because at 1:00 P.M., when the temperature was 104°, the relative humidity was 23 per cent. The dewpoint for such air would be 64°. Winds blowing across dry desert land during the previous night had kept the relative humidity in the date garden at a low level.

It was found that the relative humidities within both the paper and the cloth covers tended to be higher at most times of the day than those outside. The air temperatures about the dates were also affected by the covers: The air under brown paper covers attained a higher temperature level than that under white paper covers. During the period of direct radiation, the air on the exposed side of a paper-covered bunch was 2-9 degrees Fahrenheit warmer than that on the opposite side, and as much as 11 degrees warmer than that at the center. During the day, outside air temperatures were as much as 7 degrees cooler than those just inside the exposed surface of a brown paper cover.

RESULTS

Fruit Injury Caused by Sunburning of Fruitstalks and Fruitstrands.— Normal development of dates depends on the flow of sap through the fibrovascular elements of the fruitstalk and fruitstrands. When the tissues including these elements are killed by heat, there appears to be a reduction or stoppage of sap flow; this results in the wilting, and finally in the shriveling, of fruits which are dependent on these particular elements. The exposed surfaces of dates may also be injured directly by excessive heat.

In October, 1948, after the covers had been in place for two months, the experimental fruit bunches, together with their fruitstalks and fruitstrands, were examined for symptoms of sunburning (table 2) and fruit shriveling. No injury was found on uncovered bunches, but considerable injury was discovered under some of the covers. The most severe injury occurred under brown paper covers, the least under cloth, and only moderate injury under white paper. There was some evidence that the paper covers without wax (brown A2 and white C2 covers, treatments 4 and 7) had caused less injury than the other paper covers of corresponding color. In general, the incidence of injury from sunburning was greatest on the south and southwest sides of the palm, and least on the southeast, north, and northeast sides.

Fruit Quality.— Fruit quality, as indicated by the weighted-mean ratings of samples from the different

treatments, was improved by fruit-strand separation (wire rings) and the application of Thiomate "19", and also by the use of covers (table 3). The best quality was obtained where all three types of treatment were used. Paper covers were generally superior to cloth, and white paper was superior to brown, although in Plot II the quality of fruit under the brown A1 paper covers with "breather" holes (treatment 12) was judged equal to that under the white C3 paper covers without "breather" holes (treatment 8).

Fruit Tearing Caused by Water Injury.—Tearing or violent rupturing of the skin and underlying tissues is a severe type of water injury which occurs when dates of the khalal and rutab stages of maturity become wet (8). In 1948 the first injury of this kind occurred during the storm of October 17-19. The proportion of torn fruits was noted in all samples, and the data are summarized as weighted percentages of the total fruit picked on or after October 19 (table 3). The values for Plot I were lower than those for Plot II because the dates in Plot I were in a later stage of maturity at the time of the storm than those in Plot II and were consequently less susceptible to water injury.

The reduction in fruit tearing effected by means of fruit-bunch covers was highly significant in many cases (table 3). Control B (treatment 2) was used as the basis of comparison for the significance ratings (12) because it was similar to treatments 3 to 12, inclusive, in all respects except fruit-bunch cover. Paper covers were much more effective than cloth, and for this type of injury the color of the paper was not important. The brown A1 paper covers with "breather" holes (treatment 12) allowed some rain water to wet the fruit. Perhaps the most important observation, however, was that the brown A2 and the white C2 paper covers (treatments 4 and 7), which contained no wax, protected the fruit bunches as effectively as those containing 15 per cent wax.

Fungus Spoilage.—Fungus spoilage, like tearing, was reduced in 1948 by the use of covers. In Plot I, where much of the fruit was harvested before the rainstorm of October 17-19, the fungus diseases were controlled principally by means of fruit-bunch aeration with wire rings and fungicidal treatment with Thiomate "19" (table 3). In Plot II, however, where much immature fruit remained on the bunches at the time of the rain, the covers, by keeping the fruit dry, reduced fungus spoilage both directly and indirectly; the fungus spores on the dry fruit surfaces were apparently unable to germinate for lack of moisture, the dates were not torn open to expose their sugary flesh to infection, and the deposit of fungicidal dust was not washed away. It is remarkable that in Plot II, where fungus spoilage developed to the extent of 25.4 per cent in Control A (treatment 1), and 12.7 per cent in Control B (treatment 2), such spoilage ranged from only 1.5 to 2.9 per cent in treatments 3 to 8, inclusive, and treatment 12, in which the fruit was protected by paper covers. Here again the unwaxed brown A2 and white C2 paper covers (treatments 4 and 7) gave relatively favorable results, and the cloth covers were not effective.

The percentages mentioned above indicate the proportions of fungus-infected dates in the total crop, but they give no indication of the seasonal development of the trouble. In Plot II, the incidence of fungus spoilage was well below the 5 per cent level prior to the rainstorm of October 17-19 (fig. 3). After the rain, the percentages of infected dates in Controls A and B increased in each of the four succeeding pickings. Samples of ripened dates collected December 21 showed 32 per cent rot in Control A, 21 per cent in Control B, but only 4 per cent in treatment 8, which was one of the better treatments. Stormy weather during the following month resulted in additional spoilage in the

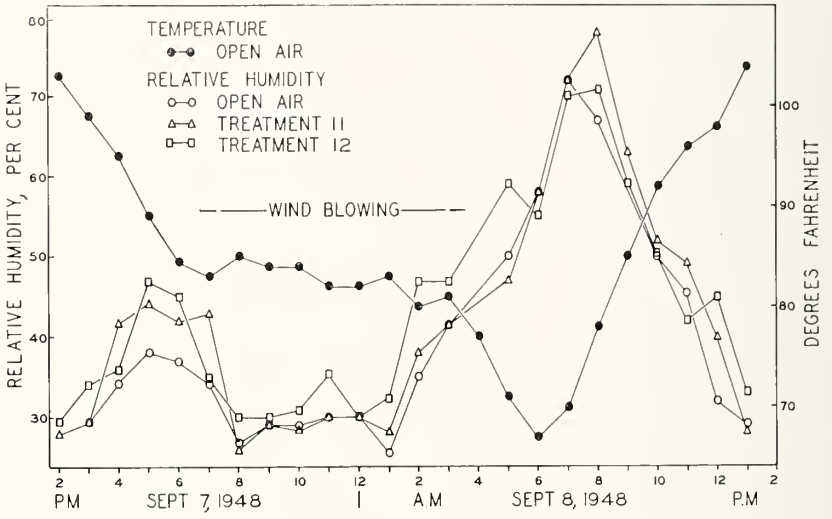

FIGURE TWO

Curves showing fluctuations in temperature of the open air, and in relative humidity of the open air and within certain experimental date-fruit bunches in Plot I, near Indio, California, September 7-8, 1948. Fruit-bunch covers for treatment 11 were constructed of a white C1 paper hood attached to a cotton marquisette tube; those for treatment 12 were brown A1 paper tubes containing "breather" holes.

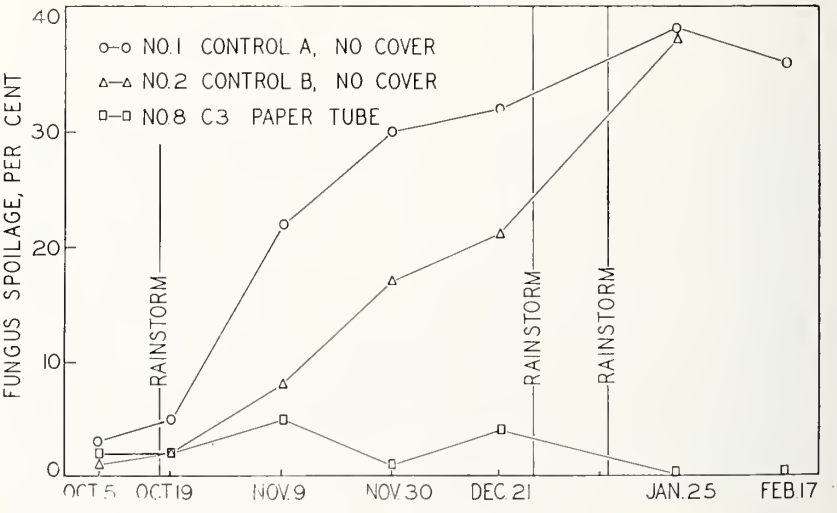

FIGURE THREE

Curves showing the effect of rainstorms and of three experimental treatments on the development of fungus spoilage in date bunches of Plot II strands, plus Thiomate "19"); No. 8, basic treatment plus white C3 in the Indian Wells district, near Indio, California: No. 1, untreated control; No. 2, basic treatment only (wire ring inserted between fruit-paper tube cover.

Table 2.—Relation of Fruit-Bunch Covers to Injury of Deglet Noor Dates by Sunburning

Treatment No.	Fruit-Bunch cover*	PLOT I Bunch No.	Exposure	Degree of sunburning†	PLOT II Bunch No.	Exposure	Degree of sunburning†
1	None (Control A)	1	Southeast	..	1	Northwest	..
		2	Northeast	..	2	South	..
		3	Southeast	..	3	Southeast	..
		4	South	..	4	Northwest	..
		5	Northwest	..	5	East	..
		6	West	..	6	Southwest	..
		....	.....	....	7	Southeast	..
2	None (Control B)	1	West	..	1	North	..
		2	North	..	2	Southwest	..
		3	East	..	3	South	..
		4	Northeast	..	4	West	..
		5	East	..	5	Northeast	..
		6	North	..	6	Southwest	..
		....	.....	....	7	East	..
3	Brown A1 paper tube	1	Southwest	xxx	1	Northeast	..
		2	West	..	2	South	x
		3	North	xx	3	Southwest	..
		4	Northeast	xx	4	Northwest	x
		5	East	x	5	Northeast	..
4	Brown A2 paper tube	1	West	xx	1	East	..
		2	Northwest	..	2	South	x
		3	South	xx	3	West	x
		4	South	x	4	North	xx
		5	Northeast	xx	5	East	xx
5	Brown A3 paper tube	1	South	xxx	1	Southeast	xx
		2	West	xxx	2	Northeast	x
		3	Southwest	xx	3	Southwest	xx
		4	North	xx	4	Northwest	xx
		5	Northwest	xx	5	North	x
6	White C1 paper tube	1	West	x	1	Southeast	..
		2	Southeast	xx	2	North	..
		3	East	xxx	3	Southeast	x
		4	South	..	4	Southwest	x
		5	Northwest	x	5	Northwest	..
7	White C2 paper tube	1	Southeast	..	1	Northwest	..
		2	South	x	2	Southwest	x
		3	Northeast	..	3	North	..
		4	Southeast	..	4	East	..
		5	East	..	5	Southwest	..
8	White C3 paper tube	1	East	x	1	West	x
		2	Northwest	x	2	Northwest	..
		3	North	..	3	North	..
		4	East	..	4	Northeast	..
		5	Southeast	..	5	North	xx
9	Water repellent muslin tube (closed)	1	South	..	1	Southwest	..
		2	Northwest	..	2	West	..
		3	Northeast	..	3	Northeast	x
		4	Southwest	xx	4	North	..
		5	Southwest	..	5	Southeast	..
10	Cotton marquisette tube (closed)	1	East	xx	1	South	x
		2	Southeast	..	2	Southwest	x
		3	West	..	3	Northwest	x
		4	North	..	4	Northwest	..
		5	Northeast	..	5	Southeast	..

Table 2. (Continued)

Treatment No.	Fruit-Bunch cover*	PLOT I Bunch No.	PLOT I Exposure	PLOT I Degree of sunburning†	PLOT II Bunch No.	PLOT II Exposure	PLOT II Degree of sunburning†
11	White C1 paper hood; cotton marquisette tube (closed)	1	East	..	1	Southeast	..
		2	Southeast	..	2	Southeast	..
		3	Southwest	x	3	West	..
		4	Southwest	x	4	Southwest	x
		5	North	..	5	Northeast	x
12	Brown A1 paper tube with "breather" holes	1	Northeast	x	1	Southwest	..
		2	East	xx	2	North	..
		3	South	xxx	3	Northeast	..
		4	Southwest	xx	4	South	x
		5	West	xx	5	South	x

*See text for explanation of designations for date-bunch covers.

†Explanation of symbols:

.. No burning of fruitstalks or strands; no injury to fruit.

x Slight burning of fruitstalks or strands; no shrivel or visible injury to fruit.

xx Moderate burning (1-5 strands); fruit shriveled.

xxx Severe burning (6 or more strands or more than one-fourth fruitstalk); fruit shriveled.

Table 3.—Effect of Various Treatments on Fruit Quality, Tearing Caused by Water Injury, Fungus Spoilage, and Insect Infestation of Deglet Noor Dates in Plots Near Indio, California, 1948

Treatment No.*	Fruit-bunch cover	Total amount of fruit (kg.)		Fruit-quality rating (10 = perfect)		Tearing from water injury (per cent)†		Fungus spoilage (per cent)		Infestation by Pyralid moths (per cent)		Infestation by Nitidulid beetles (per cent)	
		Plot I	Plot II	Plot I	Plot II	Plot I	Plot II	Plot I	Plot II	Plot I	Plot II	Plot I	Plot II
1	None (control A)	68.3	76.8	3.9	4.4	39.7	53.7	11.6	25.4	1.20	0.10	0.80	2.60
2	None (control B)	72.5	95.7	5.6	4.7	22.6	56.5	2.1	12.7	0.80	0.20	0.50	1.80
3	Brown A1 paper tube	49.1	63.8	5.7	6.9	8.0	4.4‡	0.6	1.5§	0.20	0.20	0.00	0.20
4	Brown A2 paper tube	52.1	66.4	6.3	6.9	2.0‡	5.4‡	1.6	1.6‡	1.00	0.00	0.00	0.10
5	Brown A3 paper tube	51.0	58.7	5.7	6.6	4.4‡	4.6‡	0.9	2.0‡	0.30	0.00	0.08	0.40
6	White C1 paper tube	50.2	60.0	5.8	6.8	4.1‡	4.5‡	1.1	2.9§	0.10	0.08	0.10	0.80
7	White C2 paper tube	51.2	62.2	6.2	7.0	3.5‡	5.3‡	0.8	1.8§	0.09	0.00	0.00	0.20
8	White C3 paper tube	49.4	70.4	6.5	7.1	0.0‡	5.9‡	0.7	2.2‡	0.20	0.00	0.00	0.08
9.	Water-repellent muslin tube (closed)	49.6	60.4	5.7	5.8	11.0§	17.4‡	3.4	11.1	0.00	0.00	0.00	0.00
10	Cotton marquisette tube (closed)	52.1	65.0	5.9	5.4	24.4	33.6‡	1.1	11.6	0.00	0.00	0.09	0.00
11	White C1 paper hood; cotton marquisette tube (closed)	45.9	62.3	5.4	5.6	15.3	28.4‡	2.8	6.2	0.09	0.07	0.09	0.00
12	Brown A1 paper tube with "breather" holes	55.9	64.5	5.9	7.1	3.3‡	8.1‡	0.9	2.0§	0.30	0.00	0.08	0.08

*All treatments except No. 1 included fruitstrand separation by wire rings and fungicidal dust treatment with Thiomate "19".

†Refers only to fruit picked on or after October 19, 1948.

‡Difference, in comparison with Control B, significant at the 1 per cent level, as shown by the "t" test (12).

§Significant at 5 per cent level.

controls, but fruit in treatments 3 to 8, inclusive, and treatment 12 showed little effect. This is a graphic illustration of the relation of environment to the development of fungus spoilage, and of the possibility of disease control by means of simple preventive treatments.

Included among the many microorganisms responsible for fungus spoilage were species of *Aspergillus, Alternaria, Pleospora, Penicillium, Hormodendrum, Diplodia,* and *Rhizopus,* as well as various yeasts and bacteria. Black forms of *Aspergillus* were especially common during the warmer weather of the early harvest season, but became relatively scarce toward the end. No visible infection developed in many of the torn dates.

Insect Infestation.—The infestation of dates by both nitidulid beetles and pyralid moths[5] was less in 1948 than in the two previous years. In Plot I, in the bunches receiving no treatment, 1.2 per cent of the dates were infested with pyralid moths and 0.8 per cent were infested with nitidulid beetles; and in Plot II, in the bunches receiving no treatment, 0.1 per cent of the dates were infested with pyralid moths and 2. 6 per cent were infested with nitidulid beetles (table 3). Most of the bunches receiving treatments showed a reduction in insect infestation, as compared with those receiving no treatment. No definite conclusion can be drawn as to the value of the treatments, however, owing to the low insect infestation of the untreated bunches.

Although there were many beetles in the test plots during the summer of 1948, fruit infestation, in general, did not become serious, probably because of the cool weather that prevailed during much of the picking season. It has been observed that as the mean average temperature drops below 80° F., the rate of development of these insects slows down considerably. After the rain of October 17-19, there was much torn and fungus-infected fruit in the uncovered bunches, but the insect infestation remained low.

Physical Properties and Comparative Costs of Paper Date-Bunch Covers.—Unused and used experimental paper covers of all types were returned to the manufacturer for testing at the end of the fruit harvest. The unused covers had been stored at Riverside while the used covers were being exposed to the weather and to fruit-picking operations in Plot II for a period of six months, beginning August 17, 1948. Three standard tests which were thought to be indicative of the usefulness of the paper cover in the orchard were applied to dry and wet samples of all the types submitted. These tests included (a) bursting strength (Mullen) (14), (b) tensile breaking strength (15), and (c), internal tearing resistance (13).

Tests on the unused paper covers showed that the brown paper was stronger than the white (table 4). Since both papers had come from the same stock, it was apparent that the white paper had lost strength during the bleaching process. Of the types of processing employed in the manufacture of these covers, the strongest papers were produced by the one using the higher-than-normal rosin size plus the Melamine wet-strength treatment (brown A2 and A3 paper covers). The brown A1 paper covers treated with normal rosin size and 15 per cent wax, like those now used commercially, were inferior in strength. Of both the brown and the white papers tested, those containing wax were weaker than those without wax.

Tests on the used paper covers indicated that, in general, the strength of the paper had decreased with use (tables 4 and 5). In two cases the used paper was slightly stronger than the unused, but the significance of these findings may be questioned. Lacking any test that would in itself give a reliable indication of durability, and not knowing the relative importance of the above-mentioned physical tests in this regard, we obtained a tentative index of durability by averaging the percentages of retained strength and internal tearing resistance (table 5). Although these tentative index numbers may be of questionable validity, since certain tests should bear more weighting than others, they offer a basis of comparison which is at least relatively good. The highest index rating, 89.4, was that of the brown A2 paper cover. The commercial brown A1 paper cover rated 83.2, and the white C3 paper cover, only 67.1. The brown A3 paper cover, although originally one of the strongest, had an index number of 71.9.

In addition to testing the strength and durability of the paper covers,

[5] The raisin moth, **Ephestia figulilella** Greg., and the Indian-meal moth, **Plodia interpunctella** (Hbn.), both of the order Lepidoptera, family Pyralidae.

Table 4.—Relative Strength and Internal Tearing Resistance of Unused and Used Paper Tubes from the Date-Fruit-Spoilage Experiments, 1948*

Treatment No.	Paper fruit-bunch cover		Bursting strength (Mullen) (lbs. per sq. in.)		Tensile breaking strength, machine direction (lbs. per in. width)		Internal tearing resistance (per cent of basis weight)			
							Machine direction		Cross machine direction	
	Type	Condition	Dry	Wet†	Dry	Wet‡	Dry	Wet‡	Dry	Wet‡
3 and 12	Brown A1	Unused	22.0	17.6	28.4	8.4	194	228	218	224
		Used§	17.6	19.0	24.0	7.8	142	169	152	175
4	Brown A2	Unused	28.9	25.0	28.4	9.1	196	277	255	259
		Used	25.4	24.2	30.8	8.7	172	203	224	231
5	Brown A3	Unused	28.4	20.9	31.3	13.4	191	264	229	266
		Used	20.9	15.4	20.1	8.0	157	188	197	170
6	White C1	Unused	16.1	14.3	17.4	6.9	115	110	135	106
		Used	14.3	13.2	15.6	5.1	90	65	101	74
7	White C2	Unused	26.6	21.6	34.6	10.4	164	195	206	204
		Used	21.6	12.9	26.0	6.5	138	138	174	150
8	White C3	Unused	24.6	16.1	33.8	14.4	139	163	218	151
		Used	16.1	11.0	19.6	8.6	110	98	158	110

*Data supplied by R. S. Wertheimer, Resident Manager, Longview Fibre Company, Longview, Washington. (See 13, 14, 15.)

†Samples soaked in water 10 minutes at 70° F.

‡Samples soaked in water 60 minutes at 70° F.

§Exposed to weather and to fruit-packing operations in Plot II for a six months' period beginning August 17, 1948.

the manufacturer estimated costs to the date grower as of April 4, 1949 (table 5). These figures were described as being approximate and "based on various fluctuating costs which may or may not prevail in the future." Least expensive was the brown A2 paper cover, which had also been found to be the strongest and the most durable. Only 12 per cent more expensive was the white C2 paper cover, while the commercial brown A1 cover was 27 per cent more expensive.

DISCUSSION

The use of covers for date bunches has tended to increase injury from checking and sunburning, and to decrease injury from tearing, fungus infection, and infestation by insects and birds. The moisture of transpiration trapped by covers during rainstorms and other humid weather is undoubtedly conducive to some fungus infection, but this injury is usually small in comparison with that which develops in uncovered fruit bunches where rain water wets the dates. The infestation by nitidulid beetles may also be limited indirectly by the date covers because these insects are attracted principally to fungus-infected dates.

In this study efforts were directed toward the possibility of reducing the injurious effects and increasing the beneficial effects of date covers, especially for the Deglet Noor variety. The ten kinds of experimental covers differed widely in certain characteristics. Although no cover embodied all the best features, certain covers were outstanding because of several desirable qualities.

The cloth covers excluded insects but were relatively expensive and were ineffective against tearing and fungus infection. The paper covers, especially the brown ones, increased sunburning, but were generally effective against tearing and fungus infection. The white paper covers gave slightly better fruit quality than the brown, except in the case of the brown A1 paper covers containing "breather" holes. Perhaps the most important differences between the paper covers were those of strength, internal tearing resistance, and relative cost. Tests made by the manufacturer indicated that the bleaching process had weakened the white papers, and that both the brown and the white papers had lost strength through use.

The most outstanding cover from the engineering standpoint was the brown A2 paper cover made from paper processed with higher-than-normal rosin size plus the Melamine wet-strength treatment and creped to 33 1/3 per cent stretch, but containing no wax. This cover was stronger and more durable than any other in the series, and was also the least expensive. Under present conditions it would cost only about four-fifths as much as the brown A1 waxed paper cover that is now used commercially. In the orchard the brown A2 paper cover was satisfactory in all respects except for sunburning of fruit, and in this it was probably no worse than the present commercial cover. The brown A2 paper was somewhat less pliable than the brown A1 paper, but was lighter colored. Since A2 was equal to or better than A1 in several important qualities, its use on a broader experimental basis seems to be warranted. The white C2 paper cover should also receive attention because of its superiority in regard to sunburning. Interested growers might experiment with these new covers by using the white C2 paper covers on fruit bunches on the south and southwest sides of the palms, where sunburning is most common, and the brown A2 paper covers on the remaining bunches. The shade from a full crown of leaves would also tend to reduce the danger of sunburning.

For the most effective control of date fruit spoilage in the Deglet Noor variety, the date grower should use, in addition to various improved cultural practices, a combination of disease- and pest-control measures such as: (a) wire rings for fruit-bunch aeration, (b) Thiomate "19" against fungus infection, (c) improved paper covers against fruit tearing and bird injury, (d) sulfur dust against date mites, and (e) orchard sanitation against nitidulid beetles. The use of improved paper covers, although important, is not enough in itself to insure the maximum degree of control now possible under practical conditions. The date grower, faced with economic considerations, must decide how far he should go in protecting his fruit. Since fruit spoilage is the most serious hazard in date production, and since high-quality fruit is unusually desirable, more so now than during the war, he should take all steps that are practicable.

SUMMARY

Progress is reported in experiments in two field plots on the effects of different types of date-bunch covers on the control of fruit spoilage of the Deglet Noor date. All date bunches except those of the untreated Control A were given a basic treatment of fruitstrand separation (by wire rings) and fungicidal dust (Thiomate "19"). Bunches of Control B had the basic treatment but no covers.

Date-bunch covers were of three general types: paper, cloth, and a combination of paper and cloth. The paper used (No. 1 brown Kraft, bleached and unbleached) was processed in three ways, and the paper covers were designated, accordingly, as brown A1, A2, and A3, and white C1, C2, and C3. Certain covers of brown A1 paper were made with "breather" holes. Cloth covers were of two types, one of water-repellent muslin and the other of untreated cotton marquisette. Combination covers were made with a white C1 paper hood attached to an untreated cotton marquisette skirt. All covers were made in the form of tubes, but cloth covers were longer than paper covers and were closed at the bottom.

Table 5.—Retention of Strength and Internal Tearing Resistance of Paper Tubes Used as Date-Bunch Covers for a period of Six Months, and Relative Cost*

Test	Condition of paper	Brown paper cover			White paper cover		
		A1	A2	A3	C1	C2	C3
		per cent	per cent	per cent	per cent	per cent	per cent
Bursting strength (Mullen)	Dry	80.0	86.5	73.6	89.0	81.2	65.4
	Wet†	108.0	96.6	73.8	92.2	59.5	68.5
Tensile breaking strength, machine direction	Dry	84.5	108.4	64.5	89.6	75.2	58.0
	Wet‡	93.3	84.7	59.7	73.9	62.5	59.7
Internal tearing resistance, machine direction	Dry	77.3	87.8	82.2	78.3	84.2	79.2
	Wet‡	74.2	74.1	71.2	59.1	70.8	60.2
Internal tearing resistance, cross machine direction	Dry	69.8	87.9	86.1	74.9	84.5	72.5
	Wet‡	78.2	89.3	63.9	69.8	73.6	72.9
Tentative index of durability (average)		83.2	89.4	71.9	78.4	73.9	67.1
Relative cost to grower§ (A2 tube = 100 per cent)		127.0	100.0	135.0	141.0	112.0	149.0

*Based on data supplied by R. S. Wertheimer, Resident Manager, Longview Fibre Company, Longview, Washington. (See table 4.)

†Samples soaked in water 10 minutes at 70° F.

‡Samples soaked in water 60 minutes at 70° F.

§Figures approximate; based on prices as of April 4, 1949, and subject to change.

Air temperatures reached higher levels under brown paper covers than under white. Injury from sunburning was most pronounced under brown paper, least under cloth, and moderate under white paper. Uncovered bunches were not burned.

Highest fruit quality resulted from a combination of the basic treatment and paper covers. White paper covers gave slightly better results than brown, although brown A1 paper covers with "breather" holes compared favorably with white paper covers without "breather" holes.

Fruit tearing caused by water injury was controlled much more effectively by paper covers than by cloth. Covers of unwaxed brown A2 and white C2 paper given higher-than-normal rosin size plus the Melamine wet-strength treatment were as effective as similar (A3 and C3) paper covers containing 15 per cent wax.

Fungus infection was controlled mostly by means of the basic treatment in Plot I, which was situated in a district in which fruit matured early. Paper covers of all kinds were very effective, however, in controlling fungus infection in Plot II, where much fruit was in a susceptible stage of maturity at the time of a rainstorm on October 17-19. The brown A2 and white C2 paper tubes gave relatively favorable control, but the cloth covers were ineffective.

No conclusions were drawn from the data on insect infestation.

Three standard tests on the physical properties of unused and used paper covers indicated that the unwaxed brown A2 paper was the strongest and most durable of those used; it was also the least expensive. The unwaxed white C2 paper was also outstanding.

The use of improved paper covers is considered to be very important in the control of date-fruit spoilage, but the paper cover is not enough in itself to insure the maximum degree of control that is now possible. A combination of protective measures, including date covers, is recommended.

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The Salt Problem and the Salt Tolerance of Irrigated Crops

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Agriculture in the Coachella Valley is in a transition stage owing to the completion of the Coachella branch of the All American Canal and the fact that canal water from the Colorado River will soon be available for irrigation in the Coachella Valley.

The availability of this water will result in a great increase in the acreage now under irrigation, and ultimately between 55,000 and 70,000 acres will be under irrigation in the Coachella Valley County Water District. This additional supply of water for irrigation will be of tremendous value to the Valley, but it will present new problems which should be well understood by those interested in the agricultural development of the Valley. I would like to discuss some of these new problems which have a bearing on the agricultural economy of the Coachella Valley and which are related to the type of research work being carried on by our Laboratories.

The first problem to consider is the quality of irrigation water. Quality of water for agricultural use is determined primarily upon three characteristics, (1) the total amount of soluble salts in the water, (2) the amount of sodium in the water, usually expressed as a percentage of the total bases (calcium, magnesium, sodium, potassium), and (3) the boron content of the water. In some instances there is a fourth characteristic that requires consideration—the carbonate-bicarbonate composition of water, but this is not a factor in connection with your water problem.

In order to have a basis of comparison, let us first consider the quality of the water which is now being used in the Valley and which is obtained almost entirely from ground water supplies. A series of hydrologic studies by Huberty, Pillsbury and Sokoloff[1] provide the best ref-

[1] Data in Tables 1-A and 1-B are selected from "Hydrologic Studies in Coachella Valley, California", Huberty, M. R., Pillsbury, A. F., and Sokoloff, V. P., Calif. Agr. Exp. Sta. 1948. (see Table 4.)

erence on this subject and I am basing my statements largely on their work.

In the studies noted above, an investigation was made of the quality of Coachella Valley ground water from 117 wells. The data are summarized in Tables 1-A and 1-B:

Table 1-A gives the total salt content of the wells sampled in parts per million, tons per acre foot, and electrical conductivity expressed as micromhos/cm. In the last column the number of wells in each category with respect to salt content is given. It will be noted that approximately 70 percent of these wells contained less than 300 p.p.m. of salt and approximately 85 percent have less than 600 p.p.m. This means that in the main the well waters are of good quality with respect to this characteristic, since we do not regard total salt content as a serious consideration unless it exceeds 700 to 800 p.p.m.

In Table 1-B the same wells are characterized on the basis of their sodium content and are placed in three categories—those having less than 50 percent sodium, those of 50 to 70 percent sodium, and those in which the sodium percentage exceeds 70 percent. In this instance, it will be noted that slightly better than 37 percent have sodium values in excess of 70 percent. In general, water having more than 60 percent sodium is regarded as of doubtful quality; but there are several soil conditions which should be taken into account when determining the feasibility of using high sodium waters. These include the physical characteristics of the soil such as texture, the presence or absence of gypsum, and drainage. In the studies by Huberty et al., more than one third of the wells sampled might be regarded as of doubtful quality with respect to sodium, and there is an intermediate group of 20 wells in which the water is marginal on the basis of the sodium content.

When boron content exceeds one p.p.m. it may be injurious to the more sensitive crop plants whereas semi-tolerant or tolerant crops may grow satisfactorily when the boron content of the irrigation water is as high as 2 or 3 p.p.m.[2] In general, boron is not a serious factor in the well water of the Valley and only an occasional well has been found to contain boron in excess of 1 p.p.m.

In summary, we can say that for the most part the quality of well water now being used in the Valley is good to excellent. In some instances total salts are a little high, and more commonly the sodium content is somewhat above permissible limits.

[2] Wilcox, L. V., "Quality of Water for Irrigation Use", U.S. Dept. Agr. Tech. Bul. 962. 1948.

Table 1-A—Quality of Coachella Valley ground waters
Total salt content of 117 wells sampled

R. p. m.	T. a. f.	Conductivity micromhos/cm	No. of wells
0-300	.41	0-500	83
300-600	.41 - .82	500-1000	16
600 & over	.82	1000 & over	18

Table 1-B—Quality of Coachella Valley ground waters— sodium content, expressed as percent of total bases

No. of wells	50-70%	No. of wells	71% and above
83	36	13	34
16	9	2	5
18	8	5	5
117	53	20	44

Table 2—Quality of Colorado River Water — Yuma Gaging station

Conductivity—EC x 10^6 at 25°c	1170
Dissolved solids—tons per acre foot	1.10
parts per million	808
Percent sodium	39
Hydrogen ion concentration (pH)	7.8

Cations	E.p.m.l.[1]	P.p.m.	Anions	E.p.m.	P.p.m.
Calcium (Ca)	5.06	101	Carbonate (CO_3)	2.52	154
Magnesium (Mg)	2.30	28	Bicarbonate (HCO_3)	7.16	344
Sodium (Na)	4.70	108	Sulfate (SO_4)	2.30	82
Potassium (K)	—	—	Chloride (Cl)	.03	2
			Nitrate		
Sum	12.01		Sum	12.06	

[1] Equivalents per million

The experience in the Valley has been that little difficulty has developed from the use of the available ground water supplies.

How does the quality of the canal water from the Colorado River compare with present ground water supplies? Table 2 contains data on the quality of Colorado River water sampled at the Yuma Gaging Station.

These data are prepared by the Ruoidoux unit of our Laboratories and can be considered as representative of the river water which will be available. Comparing the same characteristics which were considered in the discussion of ground water, it will be noted that the Colorado River water contains a higher amount of salt than the well waters (808 p.p.m. or 1.1 tons per acre foot). On this basis the canal water would be a marginal class two water and would be rated as good to permissible for agricultural use. On the other hand, the percent sodium (39%) is relatively low and the water is good in this regard. Boron is not a problem in the river water.

We can conclude from these data that Colorado River water is satisfactory for irrigation purposes, if it is used properly, and if the fact that it contains more soluble salt than the water now being used is taken into consideration.

The second point to consider is the salinity of the soils in the Valley. Approximately 220,000 acres were surveyed in 1923.[3] There are four major soil series in this survey, each occupying about one-fourth of the acreage. The Coachella and Superstition soils are light gray in color and relatively coarse-textured, calcareous throughout the profile and often wind-blown. The Coachella soils are regarded as somewhat better agriculturally than the Superstition soils. The Indio series consists of alluvial brownish-gray soils which are finer textured than the Coachella series. They are located mainly in the trough of the Valley and often contain large amounts of salts. The Woodrow series consists of lake-laid soils which are heavy-textured, of mixed origin, and frequently saline.

A large area of the Valley is strongly affected by salt. This area begins as a narrow strip north of Indio and extends southward east of Indio and Coachella, gradually widening as it approaches the Salton Sea. The degree of salinization based on data from the Soil Survey[3] is given in Table 3.

In strongly affected areas the salt content may be in excess of 3 percent

[3] Kocher, A. E., Harper, W. G., Soil Survey The Coachella Valley Area, California. 1923.

in the first foot of soil on a dry weight basis, and the total salt in the soil profile may be as high as 1 to 2 percent. On the Coachella Valley Test and Demonstration Plot the salt in the first foot prior to leaching exceeded 2 percent in a few spots.

The combination of irrigation water containing some salt and soils which are saline is one which requires careful water use and proper land management if salinity is to be controlled. Of first importance is the question of drainage. Where salts are present in soils and irrigation water, adequate drainage is essential to the permanence of an irrigated agriculture. At the present time, and for the past three years, your Water District in cooperation with the University of California, the Bureau of Reclamation, and the Salinity-Rubidoux Laboratories, has been carrying on a research program with respect to drainage in the Valley. A grid of 42 two-inch observation wells has been established throughout the length and breadth of the Valley on a two mile spacing. In addition, 270 ⅜-inch observation wells (piezometers) have been installed. These wells are used to determine the present status of the ground water with respect to depth to the water table and to the quality or chemical composition of the ground water. At the present time the water table at the north end of the Valley ranges from 40 to 90 feet while at the south end, near the Salton Sea, water is reached at 4 to 25 feet. As the use of water increases on an expanding acreage in the Valley, it is very likely that water tables will rise and that provision will need to be made for adequate drainage facilities. The charges for canal water are going to be relatively low and there may be a tendency toward excessive use of water unless there is reasonable control of irrigation practices in the Valley.

Another aspect of the soil management problem is the leaching of the soils which are highly saline. The Division of Soil Survey regards a soil as being saline if it contains as much as 0.2 percent salt on a dry weight basis, and experiments at our Laboratories have indicated that most crop plants will not do well if they are grown on soils where the salinity is much above the 0.2 percent level. Therefore, leaching operations will have to be practiced in many areas and this will involve the use of a considerable amount of water. For example, in studies made in the Delta Area, Utah,[4] where some of the soils contained as much as 2.1 percent salt on a dry weight basis, it was necessary to leach with 2 to 4 feet of water in order to reduce the salt content of the soil profile to limits which would support crop growth. Following such treatments, it was possible to grow good wheat on the areas, and yields as high as 43 bushels per acre were obtained following the 4 foot applications of water.

An additional consideration in connection with use of saline water is the maintenance of a satisfactory salt balance. Unless sufficient water is applied, over and above the water requirements of the crop and the loss of water through evaporation from the surface of the soil, so that the salts in solution continue to pass through the root zone and out into drainageways, salt will tend to accumulate. As has been pointed out, Colorado River water carries in solution 1.1 tons of salt per acre foot. If 5 to 7 acre feet per acre are applied to a given tract and no provision is made for leaching and drainage, this means that 5.5 to 8 tons of salt will be deposited on each acre per year. Such a condition would result in a build-up of salt in the soil and in a relatively short time the land would be unsuitable for agricultural use owing to the accumulation of salts in the profile.

Summing up these points it is clear that there must be careful planning and management with respect to water use. Unrestricted use of water will aggravate the drainage problem while use of too little water will accentuate the salt problem.

The final point is the selection of suitable crops on the basis of their relative salt tolerance. As the agriculture of the Valley expands, and assuming proper land management; it is expected that there will be progressive improvement in the salt status of the soils. However, it is probable that there will always be some salt to contend with in the Valley. The success of agriculture in such instances will depend in part upon the selection of crops which are relatively salt tolerant. For example, sugar beets and alfalfa are regarded as salt tolerant plants, while various varieties of beans are relatively poor in salt tolerance. Lettuce, carrots, cabbage, cauliflower, and sweet corn may be regarded as intermediate in salt tolerance. The date palm has good salt tolerance, but there is no question but that it does better if the salinity of the soil is reduced. Grapes are moderately salt tolerant, while grapefruit and other varieties of citrus are not especially tolerant to saline conditions.

These are some of the problems which should be understood by those who are looking forward to the development of a highly successful agriculture in the Coachella Valley. The situation is not critical, nor is it one which should be regarded with undue pessimism; but, on the other hand, the salt problem should not be ignored. You should face the facts, recognize the new and changing conditions which will affect irrigation drainage, and land management in the Valley, and develop a plan of action to forestall difficulties which might become serious in the absence of a well conceived and well executed agricultural program.

Table 3—Degree of Salinization in the Coachella Valley Area

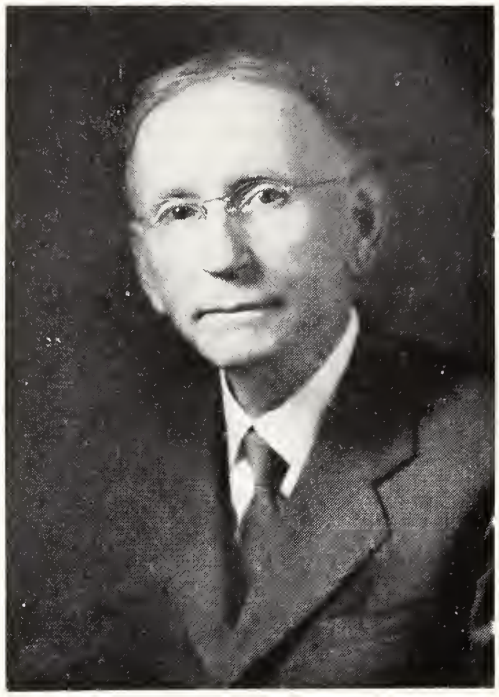
Degree of Salinization	Acres	Percent
Strongly affected area	36,672	16.7
Moderately affected area	16,000	7.3
Salt free area	148,928 [1]	67.6

[1] Includes 77,504 acres of rough, broken, and non-agricultural lands.

[4] Reeve, R. C., Allison, L. E., Peterson, D. F. Jr., Reclamation of Saline-Alkali Soils by Leaching. Utah Station Bul. 335. 1948.

Howard Samuel Fawcett

1877-1948



Howard Samuel Fawcett, Professor Emeritus of Plant Pathology of the University of California Citrus Experiment Station, died at Riverside, California, December 12, 1948. Botanical science thus loses a world authority. Professor Fawcett was an outstanding investigator of citrus diseases, his chosen field, and he initiated investigation of pathological troubles of the date palm in California.

He was born on a farm near Salem, Ohio, on April 12, 1877. He received his early education at Salem and at a Friends' preparatory school in Westtown, Pennsylvania. In 1901 he entered Iowa State College and, working his way as a teaching assistant to Dr. L. H. Pammel, completed the science course for the B. S. degree in 1905. He filled the position of Assistant in Botany and Horticulture at the University of Florida during the year following his graduation and became Assistant Plant Pathologist of that institution in 1907 and Plant Pathologist in 1908. In 1908 he earned his M. S. degree there. During his seven years in Florida he made important contributions on the fungus diseases of citrus insects, on scaly bark and gummosis of citrus trees, and on stem-end rot of citrus fruits.

In 1912 Dr. Fawcett accepted the position of Plant Pathologist with the California State Commission of Horticulture, his immediate objective being to investigate the destructive gummosis or footrot disease that was ravaging the citrus groves of that state. After a year with the Commission he joined the staff of the University of California as Associate Professor of Plant Pathology, continuing his work on gummosis. During the next three years he isolated the causal fungi, proved their relationship to the disease, and developed successful methods of treatment—results of great importance to the industry.

The years 1916 to 1918 were spent on leave at Johns Hopkins University where under Dr. Burton E. Livingston he investigated the temperature relations of certain fungi parasitic on citrus trees, and developed apparatus for temperature control which has proved very useful in botanical investigations. He received the Ph.D. degree at that institution in 1918.

As Professor of Plant Pathology in the University of California and Plant Pathologist in the Agricultural Experiment Station, Dr. Fawcett served the University and State of California from 1918 to 1947, when he became Professor Emeritus. He turned over the administrative duties of the Division of Plant Pathology to his successor in 1946 to devote himself to research on diseases of citrus. He continued intensively active and productive until his death on December 12, 1948. Upwards of 300 articles were contributed to scientific and industrial journals. He introduced the scraping method for citrus scaly bark (psorosis) in 1922, eleven years before he demonstrated the virus nature of that malady. His discovery of the causes of gummosis and psorosis and his development of practical means of control have been of inestimable value in the successful production of citrus in California and other areas. During the last few years he played the leading role in the investigation of the cause of quick decline of orange trees, demonstrating its virus nature. Quick decline and other virus and virus-like diseases of citrus, including stubborn disease of sweet orange, wood pocket of lemon, bark shelling (exocortis) of trifoliate orange rootstocks, and the various forms of scaly bark were his major research interests in recent years. The great importance of his work to the citrus industry is recognized by scientists and by growers and processors of citrus fruits throughout the world.

In the first edition of the textbook "Citrus Diseases and Their Control," published in 1926, he collected his own contributions and all the recorded knowledge of citrus diseases. Dr. H. A. Lee, who was joint author of the first edition, wrote certain sections on diseases in the Orient.

Dr. Fawcett studied citrus and date diseases in the Mediterranean countries of Europe, North Africa, and Palestine during 1929 and 1930, serving as a Collaborator of the United States Department of Agriculture. His principal contributions to our knowledge of date diseases were the initiation and promotion of investigation on the decline disease, and a collection of the world's knowledge of date diseases, in California Bulletin 522.

He continued investigation of citrus troubles in Brazil and Argentina in 1936 and 1937. His findings in these travels were incorporated in technical papers and in the revision of his book, which has become the standard reference and textbook in this field. In 1948 he contributed to Volume II of *The Citrus Industry* a paper on control of citrus insects by fungi and bacteria, and, as senior author, the chapter on "Diseases and Their Control." His textbook has been translated into Hebrew and may tualso be printed in Spanish and Portuguese editions. As junior contributor, he authored two editions, 1941 and 1948, a "Color Handbook of Citrus Diseases" which provides citrus growers, packinghouse men, horticultural inspectors and extension workers with a ready means of identifying citrus diseases, together with the essential information on control.

Professor Fawcett was a charter member of the American Phytopathological Society. He was vice-president of that society in 1929 and president in 1930. He was a member of Phi Beta Kappa, Sigma Xi, Botanical Society of America, Mycological Society of America, Societa Internazionale di Microbiologia (Milano) and fellow of the American Association for the Advancement of Science. His name was starred in the Fifth Edition of "American Men of Science" (1933), which means his selection then as one of the 250 leading scientists and one of the 25 leading botanists. In 1940 Dr. Fawcett was chosen to give the annual Faculty Research Lecture at the University of California at Los Angeles. Some of his outstanding work is described most fascinatingly in that lecture, "Adventures in the Plant Disease World."

Dr. Fawcett's energy and enthusiasm in his research activities, his good fellowship, patience, kindness, and fairness in all relationships with his friends and fellow investigators will always be an inspiration and guide to those of us who have been so fortunate as to have known him and been associated with him.

Surviving Professor Fawcett are his widow, T. Helen Tostenson Fawcett of Riverside, California; a daughter, Rosamond Fawcett Leuty of Whittier, California; two brothers, Luther T. Fawcett of Youngstown, Ohio, and Ralph F. Fawcett of Asheville, North Carolina; and a sister, Esther S. Stanton of Westtown, Pennsylvania.

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Contributions by H. S. Fawcett pertaining to date diseases: (1) An offshoot and leafstalk disease of date palms due to Diplodia. Phytopath. 20(4):339-344, 1930. (2) Observations on the culture and diseases of date palms in North Africa. Date Growers' Inst. Ann. Rept. 8:18-23, 1931. (3) With L. J. Klotz. Black scorch of the date palm. (Abstr.) Phytopath. 21(10): 998, 1931. (4) With L. J. Klotz. Diseases of the date palm, **Phoenix dactylifera.** Calif. Agr. Exp. Bul. 522, 47 pp., 1932. (5) With L. J. Klotz. Black scorch of the date palm caused by **Thielaviopsis paradoxa.** Jour. Agr. Res. 44(2):155-166, 1932. (6) With D. E. Bliss. The morphology and taxonomy of **Alternaria citri.** Mycologia 36(5):469-502, 1944.

The Male Pollen Bank in The Coachella Valley Test and Demonstratoin Plot

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At the Coachella Valley Test and Demonstration farm, there is now in process of being planted a border of male date palms. In planning the eight blocks of ground which make up the plot, sufficient space was left down the middle drive and along the south, north, east and west borders to establish approximately 200 male date palms.

As far as we can determine, these plantings will in no way interfere with other annual plantings of vegetables or other crops.

We, in the Agricultural Extension Service, and the plot committee have as a chief objective of this plot to be of service to all agricultural interests in the Coachella Valley. In line with this policy, the planting of a number of male off-shoots of known quality seems justified and of definite interest to valley date growers.

As many of you know, there are times when male pollen supplies have been very short. Progress has been made in learning how to store pollen from one year to the next, but this has not always bridged the gap when a heavy early bloom develops. This male date planting at the Test and Demonstration Farm is not intended as a research project. Research work on dates, we believe, should be left to others in the University of California, and the U. S. D. A. who are better equipped and staffed to handle these many problems.

It has seemed to us that, rather than border the plot with various types of trees and shrubs, dates would make a very effective border—a border typical and characteristic of the Coachella Valley agricultural landscape. Also, these male palms would require only routine care. The pollen produced by these palms could be collected and stored. This pollen then would serve as a "pollen bank" for hard pressed growers during times of pollen shortages.

This is not an invitation for date growers to plant out less male palms. Every grower of dates should plant enough males to meet his own needs without relying upon other sources for pollen. With the best of planning, there are times when shortages have occurred in the past, and will no doubt, reoccur in the future. To try and help out in such a situation is the purposes of the "pollen bank."

At the present time, we are only getting started. Last year there was planted 43 palms. These palms were donated by Jarvis, Gebhardt, and the Government Date Garden. We are still in need of additional planting material. We want to be sure however, that the planting material is of known quality and worth the effort it takes to bring the palms into bearing.

If any of you have any excess male planting material that you would like to donate to this collection, I would appreciate your getting in touch with me.

Research Study In Freezing Invert Sugar Dates

Laura L. J. Mantonya
Home Demonstration Agent, Riverside County, California

This research study "Freezing Invert Sugar Dates," was conducted at Cornell University, New York State College of Home Economics, Ithaca, New York, during the fall semester of 1948 under the direction of Dr. Faith Fenton, Professor of Food and Nutrition.

Dates for the study were obtained from the Valley Date Growers and the United Date Growers of Indio, California, and from an independent date grower, Mrs. Viola Babcock of Ripley, California. A total of sixty pounds of the soft varieties of invert sugar dates were used.

The subject for this special study in nutrition was selected because of a desire to share the fine fruit from Riverside County with as many homemakers as possible living in other parts of the country and because accurate information on the procedure to follow in freezing dates was difficult to obtain.

A six months sabbatical leave from the University of California offered the opportunity to study the freezing of Riverside County invert sugar dates. The length of time proved to be far too short for a research problem in freezing, but the results which were obtained point the way for further investigation and experimentation.

Some of this work can be conducted in Home Demonstration work of the Agricultural Extension Service if time for planning, training, and tabulating can be found. We hope that more work can be done on the study soon.

PURPOSE

In planning the study, it seemed desirable to work along two lines (1) to develop a frozen date mixture using the soft varieties of dates and (2) to test and develop recipes or make changes in standard recipes, to insure high quality date products when using the frozen date mixture. Objective tests and palatability tests were planned and conducted to determine the effect of freezing on whole dates. The handling, storing, preparation, and cooking methods which result in the retention of palatability and nutritive value were outlined and followed. Palatability tests were planned to determine which treatment of the whole dates and of the date mixture would prove most acceptable.

METHODS AND RESULTS

WHOLE DATES:

1. Ascorbic acid content of five varieties of dates was obtained using the Xylene method. Determining Vitamin C content is routine procedure for all studies done in the Foods and Nutrition Laboratory at Cornell University. The results of these objective tests are used as a control and not as a criteria of quality.
2. Several boxes each of five varieties of dates (Barbee, Halawy, Khadrawy, Zahidi, and Deglet Noor) were treated, prepared, packaged, frozen, and held at 0°F and —20°F temperatures. Ample freezing storage space for all the samples used in the study was obtained from the Institutional Management Department of the Home Economics College. Miss Katherine Harris, Head of the department, generously cooperated by allowing valuable space in both the quick-freeze compartment and in the 0°F room.
3. Five varieties of dates were treated in the following ways in preparation for freezing:
   a. Dates — per se — 200 grams (approximately) per box.
   b. Dates treated with 30% sugar sirup (¼ cup sirup in each box).
   c. Dates treated with 30% sugar sirup plus lemon juice (1 tagram ascorbic acid per ½ pint sirup).
   d. Dates treated with 30% sugar sirup plus lemon rind (1 teaspoon rind per 1 cup sirup).
   e. Dates treated with 30% sugar sirup plus lemon juice (1 tablespoon lemon juice per one cup sirup.)
   f. Dates treated with 30% sirup plus ascorbic acid plus citric acid.
4. Containers used: One half pint ice cream cartons measuring one and one-half inches in height and three inches in diameter were selected. These small containers were well paraffined and when filled were placed directly on the plates in the —20°F storage cabinet for rapid freezing. The samples held in the 0°F room were placed in single layers on trays, then stacked.
5. Palatability tests: After two preliminary palatability tests had been made, a panel of ten experienced judges tested two sets of five coded samples of one variety of dates, to determine noticeable differences between samples held at —20°F and those at 0°F. Eight judges turned in completed score cards on which were listed color, flavor, texture, moisture, and general acceptability headings—with subheadings. Differences noted and described by judges follow:

SAMPLES HELD AT 0°F

a. Effect of ascorbic acid: Samples retained more natural color and had better texture and flavor than samples that had no ascorbic acid added.
b. Texture of dates treated with sirup were described as "furry" or "rough." Some judges noted "crystalline" or "sandy" feeling in the mouth when eaten.
c. All judges noted color changes in the different samples held at 0°F. However, the more solid the pack, the fewer color changes were recorded. Judges described the color of the samples as "spotty," "uneven," "light," or "dark" or "fairly uniform" as in the case of added ascorbic acid.
d. Effect of lemon juice on flavor: "Off" flavor noted by all judges on all samples having lemon juice. The flavor was described as "stale," "sour," or "unpleasant."
e. Effect of lemon rind on flavor: This flavor was generally liked by the judges but a few added that the sample did not have a "date" flavor.
f. Skin of dates in all samples was dry, crusty, and brittle. One judge noted that skin separated from the pulp and broke into small sharp pieces when eaten. Another judge noted "skin separation" in samples packed in various sirups, while another said "all samples but No. 2 have air bubbles under the skin."

SAMPLES HELD AT —20°F

a. Judges noted that samples held at —20°F retained natural color with or without addition of ascorbic acid. (One judge commented that if —20°F storage units could be operated, there would be no need for this "crutch.")
b. Effect of lemon juice and lemon rind: Samples containing lemon juice were again described as "stale" and "unpleasant." All judges detected and recorded this flavor change. However, all judges described the samples containing the lemon rind and sirup as pleasant.
c. Texture changes in samples held at —20°F were not noticeable to judges except in two cases where one recorded that a sample packed without added sirup had "dry to normal skin" and another wrote "dry but may be normal for dates."

The following general conclusions can be made from the palatability tests: (1) Whole dates frozen and held at —20°F retain color, flavor, and texture characteristics fairly well; (2) Dates treated with lemon juice were not acceptable when frozen and held at either temperature; (3) Dates packed tightly were more acceptable than those packed loosely and held at either temperature.

PREPARED DATES:

Palatability tests on whole dates indicated that solid packs of dates frozen and held at either 0°F or at —20°F retained color, flavor, and texture fairly well. It is generally agreed that fruits prepared and frozen for future use are time and money savers. Riverside County Homemakers know that soft varieties of dates obtained in season, prepared, packaged in small containers and frozen will keep in good condition for several months.

With this information as a guide, a date mixture was prepared using pitted and chopped dates, sugar sirup, and a few grains of salt. This was cooked (185°F), cooled, lemon rind added to half the mixture, packaged and frozen at 0°F and at —20°F.

Palatability tests indicated that color, texture, and flavor remained fairly good after freezing and holding. The samples with and without the lemon rind were acceptable. One judge said the lemon masked the flavor but that she would like it in baked products. The frozen date mixture was tested in the foods laboratory at the college. Fourteen students used the mixture in standard recipes such as bread, sweet rolls, cake, cookies, pie (custard, sour cream, and plain date nut) and as toppings for desserts, and fillings for sandwiches.

For toppings and fillings, the mixture was thinned to the right spreading consistency by the addition of juice or orange marmalade.

Student comments and taste panel reports indicated that further research was necessary (1) on the basic date mixture formula; and (2) on the method of combining the date mixture with the other ingredients in the recipes.

Texture changes were marked in

the resulting product when the moist date mixture was added to the standard recipes in the conventional way. It was thought that a thicker date mixture combined in the product in layers would give better and more characteristic results.

SUMMARY

To retain the maximum percentage of nutritive value and palatability, use —20°F temperatures for quick freezing dates and date mixtures; use small cartons having as thin a layer of paper as possible; exclude air by (1) adding sirup or (2) pack pitted, finely divided or pureed dates tightly in containers; omit lemon juice in date mixture before freezing.

Further work must be done on freezing procedures of both whole dates and date mixtures and considerable testing should be conducted on the use of basic date mixtures in baked products.

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Investigations on the Life History and Control of Date Insects and the Date Mite[1]

D. L. Lindgren and L. E. Vincent[2]

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The date-producing area of the Coachella Valley, California, has increased from 605 acres in 1925 to 3,432 acres in 1948. Along with this increase in acreage there has been an increase in production, from an average of 39 pounds of dates per tree for the five-year period 1925-1929 to an average of 125 pounds per tree for the period 1944-1948 (average number of trees to the acre, 49). This increase in date acreage and production has been accompanied by an increase in acreage planted to other crops such as corn, tomatoes, melons, and grapes, and by a corresponding increase in insect infestation of dates.

According to the Annual Reports of the Date Growers' Institute, crop losses to date growers were 40-50 per cent in 1925, 60 per cent in 1939, and 60-75 per cent in 1945. Rainfall and warm, humid weather were probably the chief environmental factors in causing these losses. Observations indicated that the nitidulid beetles were very abundant in 1945, and although no records are available for 1925 and 1939, the beetles probably were present in those years, since beetle infestation of dates is closely allied with losses due to spoilage by microorganisms.

Nitidulid beetles and the date mite, *Paratetranychus simplex* (Banks), are among the most serious of the date pests. The four species of nitidulid beetles found in dates are the corn sap beetle *(Carpophilus dimidiatus* (Fab); the dried-fruit beetle *C. hemipterus* (L); the pineapple beetle *Urophorus humeralis* (Fab.); and the yellowish nitidulid *Haptoncus luteolus* (Er.) The life history of the nitidulid beetles, and possible control measures for both the beetles and the date mite, are being investigated at the University of California Citrus Experiment Station. Progress to date is reported in this paper.

NITIDULID BEETLES

LIFE HISTORY. Studies of the life history of the nitidulid beetles infesting dates have been conducted under controlled laboratory conditions, at temperatures of 65°, 70°, 80°, and 90° F. These temperatures represent the approximate means of the monthly temperatures in the Coachella Valley from April to November (table 1), the period in which dates are ripening and in which such crops as corn, tomatoes, melons, and grapes are harvested in the valley. Inasmuch as these crops are hosts of the nitidulid beetles, and are harvested before the dates, large numbers of beetles are already present in the valley before the dates are mature.

Constant-temperature cabinets showing a variation of plus-minus 2 degrees Fahrenheit from the means were used in the experiments. The in-

[1] Paper No. 604, University of California Citrus Experiment Station, Riverside, California.

[2] The writers wish to express their appreciation to E. G. Gebhardt, N. R. Jarvis, T. R. Brown, D. H. Mitchell, H. L. Cavanaugh, and L. J. Anderson for their cooperation in making experimental plots available, and to The Dow Chemical Company, Pennsylvania Salt Manufacturing Company, Julius Hyman & Company, and the American Cyanamid Company for supplying insecticides for experimental purposes.

Table 1.—Average Monthly Temperatures at Indio, California, for the 25-Year Period 1905-1930*

Month	Degrees F.	Month	Degrees F.
January	54.1	July	92.1
February	59.6	August	90.8
March	64.7	September	84.9
April	71.4	October	74.2
May	78.0	November	63.4
June	87.3	December	54.7

*Climatological Data, California Section, U. S. Department of Commerce, Weather Bureau, Vols. 9 to 34, 1905-1930.

sects were reared individually in petri dishes containing moist sand, with dates as food, and were observed from egg stage to adult. Eggs of a known age were used, and observations were made not less than twice a day.

Although four species of nitidulid beetles are found in dates, the two predominant species are the corn sap beetle and the dried-fruit beetle, which comprised 99 per cent of the beetle population in both 1947 and 1948. (The number of Deglet Noor dates infested with nitidulid beetles and with the pyralid moths *Ephestia* and *Plodia* spp. was less in 1948 than in the two preceding years, as shown in table 2.)

Results of experiments with the corn sap beetle and the dried-fruit beetle are shown in table 3. The importance of temperature on the growth of these beetles is evident. At 65° F. it required 49.2 days for the corn sap beetle to complete its life cycle, and 42.2 days for the dried-fruit beetle; at 90° the length of time dropped to 14.7 and 12.4 days, respectively. At 50° egg mortality was high, and at a constant temperature of 100° larval mortality was high.

Table 1 shows that the mean temperatures of the two or three months prior to date picking, which usually begins about the middle of September, are approximately that at which the development of these beetles is most rapid, namely, 90° F. The June drop of dates supplies food for the beetles in the date garden during these months. Since the average egg production for a single female may be as high as 500 to 1,000 eggs, laid over a period of several months, very high populations of beetles may be present in the date garden by the time picking begins. The activity of the beetles tends to slow down in October, when the mean average temperature is 74° F.

The nitidulid beetles pupate in the soil, and it is in this manner that they may overwinter, although adults may be found feeding on dates on the ground near the base of the tree at almost any month of the year. They may also be found feeding on grapefruit that has dropped to the ground and spoiled. Such rotting vegetation serves to feed the overwintering adults which will help to start the following year's infestation in the date garden.

In general, the immature forms of these beetles cannot withstand long periods of desiccation. The adults also have a predilection for moist dates, and rarely are found in dry dates. Moist dates are ever present during the growing season, since the bearing gardens on the lighter soils are usually irrigated every 7 to 14 days during midsummer (when nitidulid development is at its peak), and every 20 to 30 days during the winter. Irrigations on the heavier soils are less frequent.

The first new source of dates as food for beetles in the date garden (as contrasted with the previous year's drops which may not have been disked in) is provided by the tree's own natural method of thinning, known as the "June drop." It is into these dates that the beetles move and begin to build up a population which eventually will infest the dates in the bunches. From the time of the June drop onward, there are moist dates on the ground. These dates sour rapidly and serve as an ideal medium for beetle reproduction. Inasmuch as the larvae pupate in the soil, they can pass from the date to the soil with an almost certain chance of survival.

Thus, four factors contribute to the rapid development of nitidulid beetles in a date garden: (a) high temperatures, which promote the rapid development of the beetles and the creation of a large population within a comparatively short time; (b) a life history which includes pupation in the soil, with a high chance of survival; (c) moisture due to frequent summer irrigations; and (d) a food supply, beginning with the June drop of dates.

CONTROL. All promising insecticides obtained from the various chemical companies are tested at the Citrus Experiment Station for their toxicity to the nitidulid beetles infesting dates. The methods used are similar to those described by Lindgren, Bliss, and Barnes (1). Not only is the initial kill determined, but also the residual action—that is, the duration of insecticidal effectiveness after application. Continued toxicity is important in the control of date insects because they are constantly moving into the date bunches from outside sources. Therefore, any material applied to the dates to control these insects should not only effect a kill at the time of application, but also remain toxic for several weeks afterward; otherwise, it is practically useless.

Laboratory results indicate that the gamma isomer of benzene hexachloride, chlordan, parathion (diethyl *p*-nitrophenyl thiophosphate), and compounds Nos. 497 and 118,[3] not only give excellent initial kill, but also kill the nitidulid beetles that come in contact with any of these materials for several weeks to a month or more after application. These tests were conducted at Riverside during the cool winter months, a condition resulting in a longer residual effect than would be expected in the Coachella Valley during the hot summer months, since the higher the temperature to which these materials are exposed, the more rapid the breakdown.

The insecticidal dusts applied to dates during the 1947 season did not markedly reduce the number of beetles or infested fruit, probably because the dusts were applied too far ahead of picking time and the concentrations of insecticides in the dust formulations were too low. The dusts were applied 3 to 4 weeks prior to picking, and, this under Coachella Valley conditions, was too long a time to expect protection against the insects. The concentrations of insecti-

Table 2.—Average Percentage of Deglet Noor Dates Infested with Beetles (Nitidulids) and Moths (Pyralids, **Ephestia** and **Plodia** spp.) During the 1946, 1947, and 1948 Seasons.

Insects	1946	1947	1948
Nitidulids	10.5	19.7	1.7
Pyralids	2.3	1.0	0.6

Table 3.—Effect of Controlled Temperatures on the Length of the Immature Stages of the Corn Sap Beetle **(Carpophilus dimidiatus)** and of the Dried-fruit Beetle **(C. hemipterus).**

Species	Temp., Deg. F.	— Number of days in: — Egg stage	Larval stage	Pupal stage	Total number of days, egg to adult stage
C. dimidiatus	65	4.1	27.2	17.9	49.2
	70	3.9	18.3	11.3	33.5
	80	2.2	11.2	7.3	20.7
	90	1.6	8.2	4.9	14.7
C. hemipterus	65	4.1	21.7	16.4	42.2
	70	2.5	14.5	8.9	25.9
	80	1.6	9.2	5.6	16.4
	90	1.1	7.0	4.3	12.4

[3] Compounds manufactured by Julius Hyman & Company.

cides in the dusts used were 0.75 and 1.0 per cent.

Some insecticidal dust applications during the 1948 season indicated that a higher concentration of insecticide in the dust formulation, and timing of the application to precede picking by 10 days to 2 weeks, may have some possibilities in controlling the nitidulid beetles. Since the beetle population in general was low in 1948 (table 2), even in the bunches that received no treatments, the results of these tests were by no means conclusive and thus gave no clear-cut indication as to the effectiveness of the dust treatments.

Application of insecticidal dusts to dates prior to picking means that there is a problem of residue on these dates when they come into the packing house, although with the washing equipment now in use this should offer no serious problem, especially on dates of the Deglet Noor variety. There may be some objections to the use of insecticidal dusts on the soft dates, however, owing to the difficulty of removing the residues from such fruits.

Since the dates that drop to the ground furnish ideal breeding conditions for the beetles, the overlay of dropped dates in a 30-acre garden was sprayed in 1948 to kill the beetles present and thus prevent any further development of beetles in these dates, and to determine the effect of such spraying on the beetle population in the bunches. The sprays used were 0.75 and 1.0 per cent gamma isomer of benzene hexachloride in Diesel fuel oil. These sprays were tried in 1947, and they not only killed the nitidulids present in the date overlay, but also prevented any reinfestation of the sprayed dates for at least 4 weeks. The beetles were not abundant in 1948 (table 2), but the results of the spray experiment indicated that even though the beetles in the dates on the ground were killed by the spray, and no reinfestation occurred, there were some beetles present in the bunches. This suggests that the insects were moving into the date bunches from the surrounding area, and although spraying of the dates on the ground reduced the beetle population, it did not keep the beetles out of the bunches. Elimination of the breeding places of these insects in the date garden and in other host crops would no doubt be of value in reducing the numbers of beetles infesting the date bunches.

In the date garden, the breeding of beetles in dropped dates may be reduced to some extent by not allowing the irrigation water to wet the soil directly under the palms, where most of the dates fall. If the surface of the soil is kept dry, the dates, as they drop, will dry out, and the condition for development of the beetles will not be so favorable as with dates that are wet and sour. Further investigations are necessary in order to determine whether enough water would be available to the palm under such irrigation practice.

THE DATE MITE

LIFE HISTORY. The date mite, *Paratetranychus simplex* (Banks), is a small flesh-to-pale-amber-colored species which spins a very fine, dense webbing over the surface of the dates. The webbing is easily detected on the fruit, but the mite, being very small, is difficult to see. The translucent, white-to-pale-amber eggs of the mite are deposited on the surface of the dates among the fibrils of webbing, and the entire life cycle is passed within or beneath or along the edges of the web. As the old tissue on the surface of the date becomes hard and cracks, the mite colony gradually spreads over more surface, or new colonies are started close by.

In the Coachella Valley the date mite occurs on other palms as well as on the date palm, and it lives throughout the year on the various grasses that grow in date gardens. Usually, by June the mite becomes abundant on the dates. It injures the fruit by scarring the skin and thus causing it to harden, crack, and shrivel. Infestations in a garden are generally spotty, some bunches being heavily infested and others having few or no mites present, but observations indicate that the heaviest infestations are found on those palms bordering dusty roads. When the fruit ripens in the fall, the date mites diminish in numbers, but persist behind the fiber on the white tissue of the leaf bases, particularly on the younger leaves and on grasses, in sufficient numbers to insure infestations on the fruit the following year (2).

CONTROL. During the 1948 season, the mites were generally abundant in the Coachella Valley, appearing early and persisting in some gardens up to picking time. Several new acaracides were tested on heavily infested bunches, but none of them was so effective as sulfur. In most instances the bunches treated with the new materials had to be redusted with sulfur to avoid too much mite injury to the fruit. Table 4 gives the results of one of these tests, showing the effective control of this mite with sulfur dust, as compared with 2 per cent K-1875, bis-(*p*-chlorophenoxy)-methane, a material showing much promise in control of the citrus red mite. The materials were applied June 11, 1948. On June 24, 1948, all the bunches dusted with K-1875 had to be retreated, whereas none of the sulfur-dusted bunches required retreatment. On June 29, the K-1875 bunches were dusted with sulfur to prevent mite injury, because the K-1875 had not controlled the mite. Of the original sulfur-treated bunches, 75 per cent remained free of mites for the entire season, with a single application. Bunches treated with K-1875, parathion, and DN D-8 (dicyclohexylamine salt of dinitro-*o*-cyclohexylphenol) had to be retreated one or more times, and usually had to be treated finally with sulfur to prevent serious mite injury to the dates.

Our observations show that sulfur is the most effective and least expensive date-mite treatment, but the dust must be forced up into the bunch to give good control. A dust drift such as that obtained by driving through the garden with a power or hand duster, blowing the sulfur among the palms, or by airplane dusting, although giving some degree of control, does not provide a control to compare with that obtained when the sulfur is blown upward, directly into each bunch, depositing a film of dust over the surface of the dates. Complete and thorough coverage is especially important if there is any date-mite webbing present at the time of dusting.

SUMMARY

In the Coachella Valley, conditions are usually favorable for the rapid build-up in population of nitidulid beetles in dates (*Carpophilus dimidiatus* (Fab.), the corn sap beetle; *C. hemipterus* (L.), the dried-fruit beetle; *Urophorus humeralis* (Fab.), the pineapple beetle; and *Haptoncus luteolus* (*Er.*), the yellowish nitidulid).

Studies of the life history of the nitidulid beetles infesting dates have been conducted under controlled laboratory conditions, at temperatures of 65°, 70°, 80°, and 90° F.

Table 4.—Results of Experiments on Control of the Date Mite, **Paratetranychus simplex**, with Dusts Applied with a Hand Applicator, Thoroughly Covering Each Bunch, 1948.

Dust	Number of Date Bunches Treated June 11	Requiring Retreatment June 24	June 29	July 8	July 16
2% K-1875	80	80	80*	0	0
Sulfur	92	0	1	16	6

*Retreated with sulfur.

Since *Carpophilus dimidiatus* and *C. hemipterus* comprise 99 per cent of the nitidulid beetles present in dates in the Coachella Valley, detailed studies of these two species are discussed. At 90° F., which is the approximate mean average monthly temperature at Indio during July and August, *C. hemipterus* can develop from egg to adult in 12.4 days, and *C. dimidiatus* in 14.7 days. At 80°, it takes 16.4 days for *C. hemipterus* and 20.7 days for *C. dimidiatus* to mature, and, at Indio, there are four months during the summer when the mean monthly temperature is above 80° F. As the temperature drops to 70°, the length of time required for the development of these two species increases to 25.9 and 33.5 days, respectively; and at 65° it increases to 42.2 and 49.2 days, respectively. At 50°, results indicate high egg mortality, and at a constant temperature of 100°, larval mortality is high.

Laboratory results indicate that gamma isomer of benzene hexachloride, chlordan, parathion, and compounds Nos. 497 and 118, not only give excellent initial kill of nitidulid beetles, but also remain toxic to those that may come into contact with any of these materials for several weeks to a month after application.

Insecticidal dusts applied to the date bunches 10 days to 2 weeks prior to picking may have some possibilities in controlling the beetles in the bunches.

Spraying the date overlay on the ground with gamma isomer of benzene hexachloride killed the beetles present in the dropped dates and prevented reinfestation of these dates, but did not keep the beetles out of the bunches. This suggests that the insects were moving into the date bunches from the surrounding area.

For control of the date mite, *Paratetranychus simplex* (Banks), sulfur dust applied thoroughly to each bunch was more effective than any other material tested.

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Symposium on 1949 Frost Damage to the Date Palms

Leonhardt Swingle

We have had a cold winter, the coldest winter that I believe any of us have ever experienced in the Coachella Valley. The minimum was lower in 1937 but the average minimum was lower this year and the cold weather started early and lasted a long time. How this will affect the date palms we cannot tell as yet for the 1937 freeze influenced the crop for two years. We can talk over the damage Pacific Railroad and in that time the and what had best be done to care for the palms and this year's crop, and then talk again about it next spring when we can better appraise the 1949 cold spell.

How cold was it? The following table shows temperatures for several stations in the Coachella Valley. I understand that weather records have been kept at Indio for about 75 years or since the building of the Southern records show three severe cold spells, 1913, 1937 and 1949. In 1913 there were 11 days below freezing in January but there were no commercial date orchards. For a report and summary of 1937 get the Date Institute Reports for 1937 and 1938 which give a very thorough report of that freeze.

The following are the temperature records for early January 1949:

Frost Service Stations

64-B—Thermal-Vevers, ½ mile south and ¼ mile west of Valerie Jean's.

77—Thermal-Thermiculture Farms, 3 miles east and ½ mile south of Thermal (near canal) in alfalfa field.

60-B—Oasis-Ramsey, ½ mile east of Oasis store.

Minimum on January	3	4	5	6	7	8
64-B	36.0	18.8	16.7	26.0	28.0	26.0
77	32.2	23.0	25.5	29.0	37.0	29.1
60-B	39.0	22.0	16.0	25.0	30.0	24.8

U. S. Date Garden

	Minimum	Hours below 30° during preceeding night
Monday, January 3	37.0	
Tuesday, January 4	22.5	10
Wednesday, January 5	20.0	14
Thursday, January 6	25.5	7
Friday, January 7	26.0	4
Saturday, January 8	28.0	

In December number of nights below 32° — 15

These figures confirm the observation that the cold this year was quite spotted.

MR. CAVANAGH: "Several of you men may have observed our young date garden west of Indio which is a pretty good topic for this discussion. It was badly damaged by the freeze in 1937. We had some palms of comparable age, or at least as old as the oldest ones now. I believe the '37 freeze damage was probably greater than this last. So far, we have pruned 50-75 leaves. We tried to reduce our crop in proportion to the amount of damage, and were able to maintain a reasonable good quality. We plan to do the same this year, and in many respects, it is good to maintain a reduction of at least one-half the crop. In 1937 we made a greater reduction. I believe the leaf bunch ratio gives the best results, 8 or 9 leaves to the bunch; that is, eight to nine good green leaves to the bunch."

MR. MITCHELL: "This freeze at the home place where I live was not nearly as severe as that of '37. You will remember the results we had at the home place at that time. We had a block of young dates, about 5 acres. They were badly frozen and I let those young trees carry 3 to 5 bunches, and I did not harvest any worthwhile fruit from that block. I would have been better off if I had cut them all off. I had a fairly good crop the next year as I remember. The tall trees at the home place were hit heavily by the freeze, and yet they carried almost a normal crop. They seemed to have more vitality and reserve. This year the frost has certainly been spotted. About a mile from here we have 5-mile Ranch. It was quite badly hit by frost, and the trees were pruned to carry 6-7 bunches per tree, which ordinarily

have twice as many. I can recall that in the freeze of '37, the packinghouse was burdened with a big quantity of poor dates, and as a result I think we should get behind any recommendations for the improvement of low grade dates this fall. I believe we are going to have them anyway, even though we do think we are reducing our load by reducing the number of bunches. I think we will have quite a heavy percentage of low grade dates. Roy Nixon carried on a leaf bunch ratio experiment on our place and the number of leaves per bunch is still a good indicator of what your crop is going to be. If you have a like number of leaves per bunch, you are going to have bigger and better dates, and the small number may be poor fruit. This frost acts like a pruning—a much reduced leaf area, and I am sure that it would be a very valuable guide as to how many leaves to leave on to count how many working leaves we have left. We tried to cut the frozen leaves off as soon as we could."

MR. JENKINS: "I did everything wrong in '37. No one around the date trees knew what they were doing. I pollinated them and the leaves kept dying back through the summer. On a 10-acre block of trees about 12 years old, the fruit was very small, and a good part of it never did mature."

MR. SWINGLE: "Leaves are not through dying yet. If your garden has been kept well irrigated you do not suffer as much frost damage as those that were dry. Off-shoots just established or young trees just beginning to bear seem to be hardest hit."

MR. YOWELL: "You mention the irrigation in lessening the severity of frost. We have two tracts of dates, one is over on the west side of the valley, and it was fairly dry during the freeze, and seems to have suffered considerable damage. Another one just out of Coachella. The two coldest nights our borders were full of water, and at the present time it does not show near the damage the other tract does. Freezing that water gave us enough heat to stave off the frost. I don't know, but that seems to be the "out." It is nearly along the line of what Mr. Swingle says. If you have plenty of irrigating water in your garden, it won't freeze so severely."

DR. BLISS: "We had palms at the height of production from which we kept records. On the advice of Roy Nixon, we reduced the number of fruit bunches of the center palms down to four bunches per palm in 1937. At Oasis we thought that was too extreme a treatment and reduced them to eight bunches. In our 61 trees in 1938 we only had one palm that laid off entirely, but at Oasis the charter trees had no date bunches at all. The strength in the trees and the vitality in the trees that had been stored there before the time of the frost, was sufficient to push out about the normal number of spathes in the spring of 1937. In '38 the trees were so weakened they did not have the strength to put out a single spathe. If trees are badly frosted and your leaves are gone, the fruit is gone."

MR. SWINGLE: "We found out in 1937 that it does not pay to cut leaves off the palm till they are entirely dead. The more leaf area that can be maintained on the palm, the quicker the palm will recover and the more tonnage that can be produced. The leaves are unsightly in the half dead and dying condition but every bit of green surface helps the tree to recover its strength.

"I did not realize in 1937 that the leaves would keep on dying all summer and so left too large a crop on my palms. The result was a fair sized crop of low quality and the drain on the palm was so great that there was only about half a bloom in 1938. Growers who cut back the crop very severely in 1937 carried more good dates through to harvest and then had a nearly normal bloom in 1938. So it is all important to watch the leaf-bunch ratio and do not hesitate to cut off plenty of bunches. I do not believe the loss of leaves will be nearly so great this year but do not hesitate to cut off more bunches if the leaves keep on dying.

"If there are no more questions or observations, we will turn the meeting back to the chairman."

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